Gas Journal

INSTITUTION NUMBER

VOL. 286. 108th YEAR. LONDON, JUNE 6, 1956. Nº 4847. PRICE 2/6

THE WALKER TOWER PURIFIERS

LUSTRATION INDICATES A SET OF WELDED STEEL WALKER TOWER PURI- HAVING A CAPACITY OF 10,000,000 CUB. FT. OF GAS PER DIEM. THE IN- TION COMPRISES 5 WORKING TOWERS EACH OF 14 TRAYS OF 22ft. DIA- WITH STOCKING TOWER, STACKING BASE, TURNTABLE AND TRAY TIP- OWER. A PASSENGER LIFT GIVES ACCESS TO THE LIFTING CRANE AND TOWER PLATFORMS. THE TOWERS ARE FITTED WITH 36in. DIAMETER CTIONS AND AUTOMATICALLY-OPERATED WATER SEAL VALVES.

EACH TOWER CONSISTS OF A STACK OF WELDED STEEL TRAYS. NO OUTER CASING OR GANGWAYS ARE REQUIRED.

EACH TRAY IS OF ROBUST CONSTRUCTION. THERE ARE NO INTERNAL STIFFENERS TO INTERFERE WITH THE PURIFYING MATERIAL.

COMPACT ARRANGEMENT OF GAS CONNECTIONS.

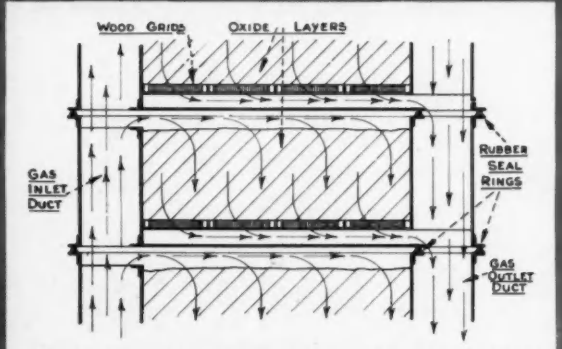
ALL WATER SEAL VALVES FOR GAS ARE CONTAINED IN THE BASE OF EACH TOWER. THEY ARE EASILY INSPECTED AND CLEANED, AND ARE ADEQUATELY PROTECTED FROM FROST.

THE WATER SEAL VALVES FOR GAS ARE OPERATED BY REMOTE CONTROL, OR ALTERNATIVELY THEY MAY BE DIRECTLY OPERATED.

MAINTENANCE COSTS ARE REDUCED TO A MINIMUM.

EACH TOWER IS TESTED TO 80in. W.G. AIR PRESSURE BEFORE BEING PUT INTO COMMISSION.

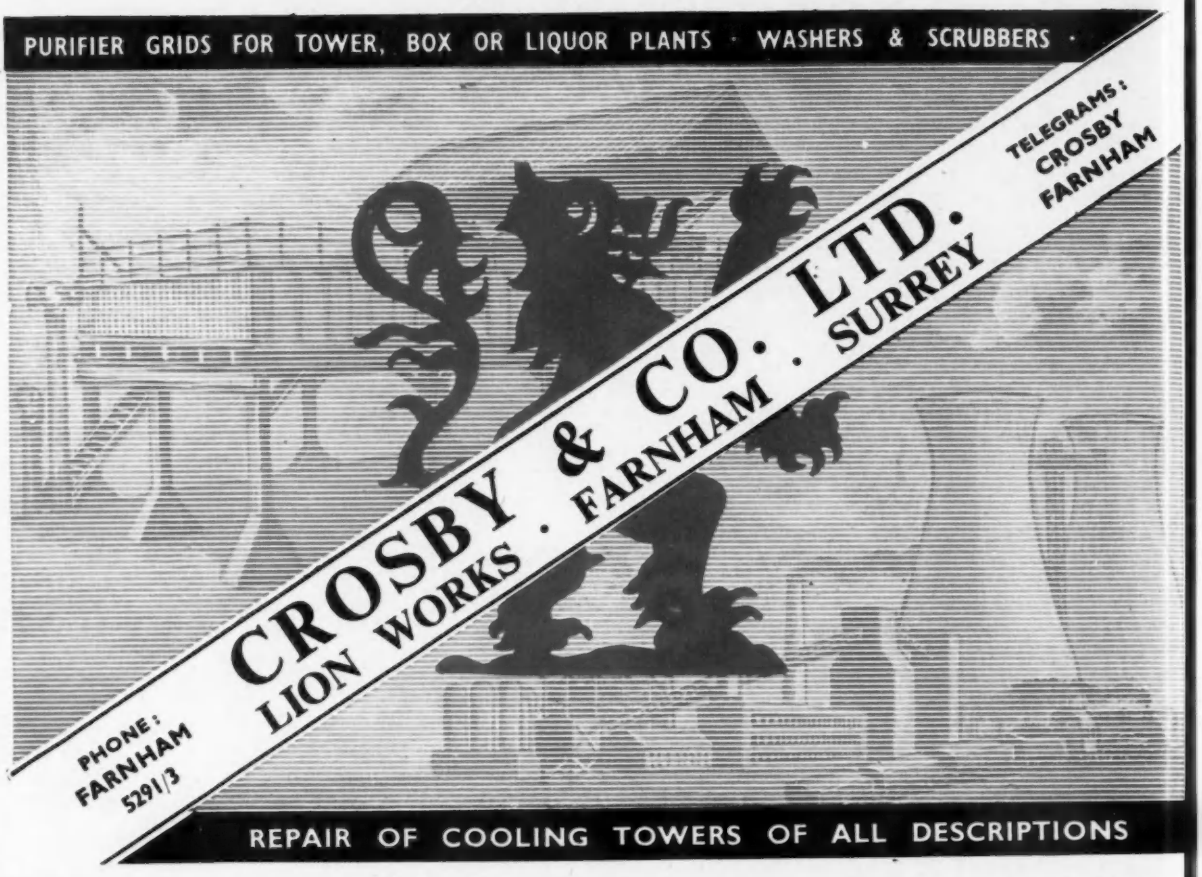
ARRANGEMENTS MAY BE MADE FOR UPWARD OR DOWNWARD OR SPLIT FLOW OF THE GAS STREAM THROUGH THE PURIFYING MATERIAL IN THE TOWER TRAYS. THE GAS FLOW MAY ALSO BE REVERSED IN EACH TOWER IF REQUIRED.



TYPICAL SECTIONAL ELEVATION THROUGH A TOWER TRAY SHOWING DOWNWARD FLOW OF GAS THROUGH PURIFYING MATERIAL. *BRITISH PATENT NO. 712628.*

& W. WALKER LTD.

NNINGTON, Nr. WELLINGTON, SHROPS.


PURIFIER GRIDS FOR TOWER, BOX OR LIQUOR PLANTS · WASHERS & SCRUBBERS ·
CROSBY & CO. LTD.
LION WORKS · FARNHAM · SURREY
TELEGRAMS: CROSBY FARNHAM
PHONE: FARNHAM 5291/3
REPAIR OF COOLING TOWERS OF ALL DESCRIPTIONS

The

DONKIN HANSON

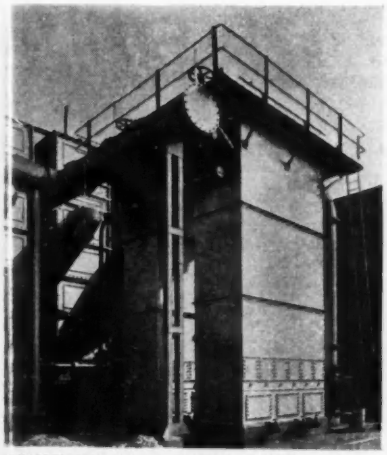
AUTO-PILOT GOVERNOR

FOR USE WITH STATION GOVERNORS

THIS PILOT GOVERNOR IS OPERATED BY AN EIGHT-DAY CLOCK, AND CHANGES THE PRESSURE TO MEET PEAK LOADS, ACCORDING TO REQUIREMENTS. A DIFFERENT LINE CAN BE GIVEN FOR EACH DAY OF THE WEEK IF REQUIRED.

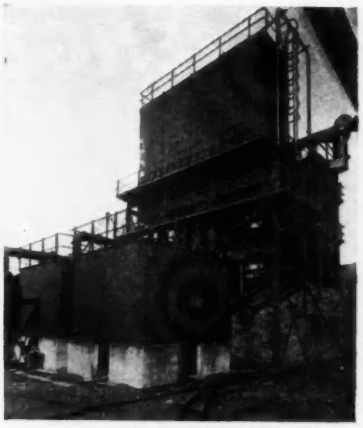
The **BRYAN DONKIN CO LTD** · Chesterfield

LONDON · MANCHESTER MEMBERS OF THE SOCIETY OF BRITISH GAS INDUSTRIES

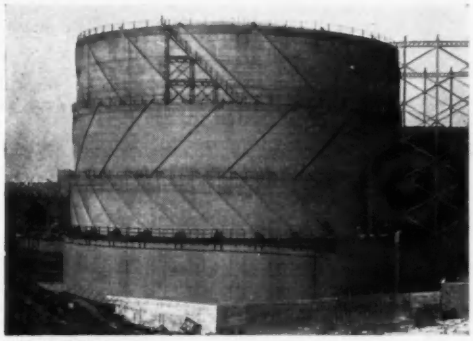


CONDENSERS WITH VERTICAL TUBES

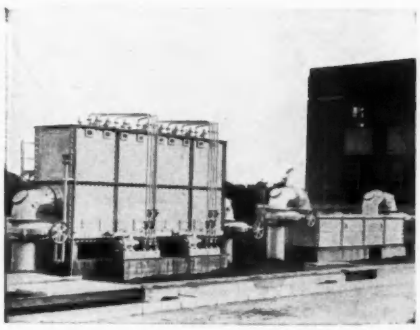
ELECTRO-DETARRERS



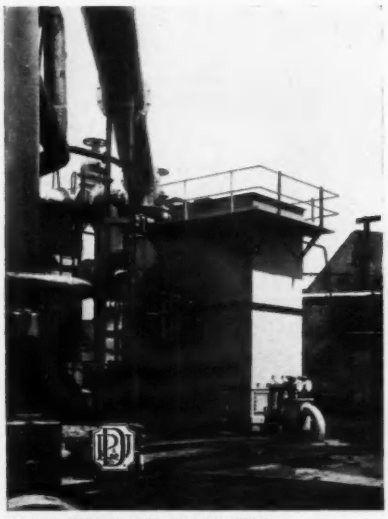
LIQUID PURIFICATION PLANT



GASHOLDERS



WASHING PLANT



CROSS TUBE FLOW CONDENSERS

HIGH QUALITY PLANT

FOR THE

GAS AND ALLIED INDUSTRIES

BY

R. & J.

DEMPSTER

LIMITED

Constructional Gas and Chemical Engineers

MAKERS OF HIGH QUALITY BY-PRODUCT and CHEMICAL PLANT - CONDENSERS - CONNECTIONS and VALVES - DETARRERS - GASHOLDERS - IRON CASTINGS - PURIFIERS - STILLS - TANKS - WASHERS - WELDED and RIVETED STEELWORK

GAS PLANT WORKS · NEWTON HEATH

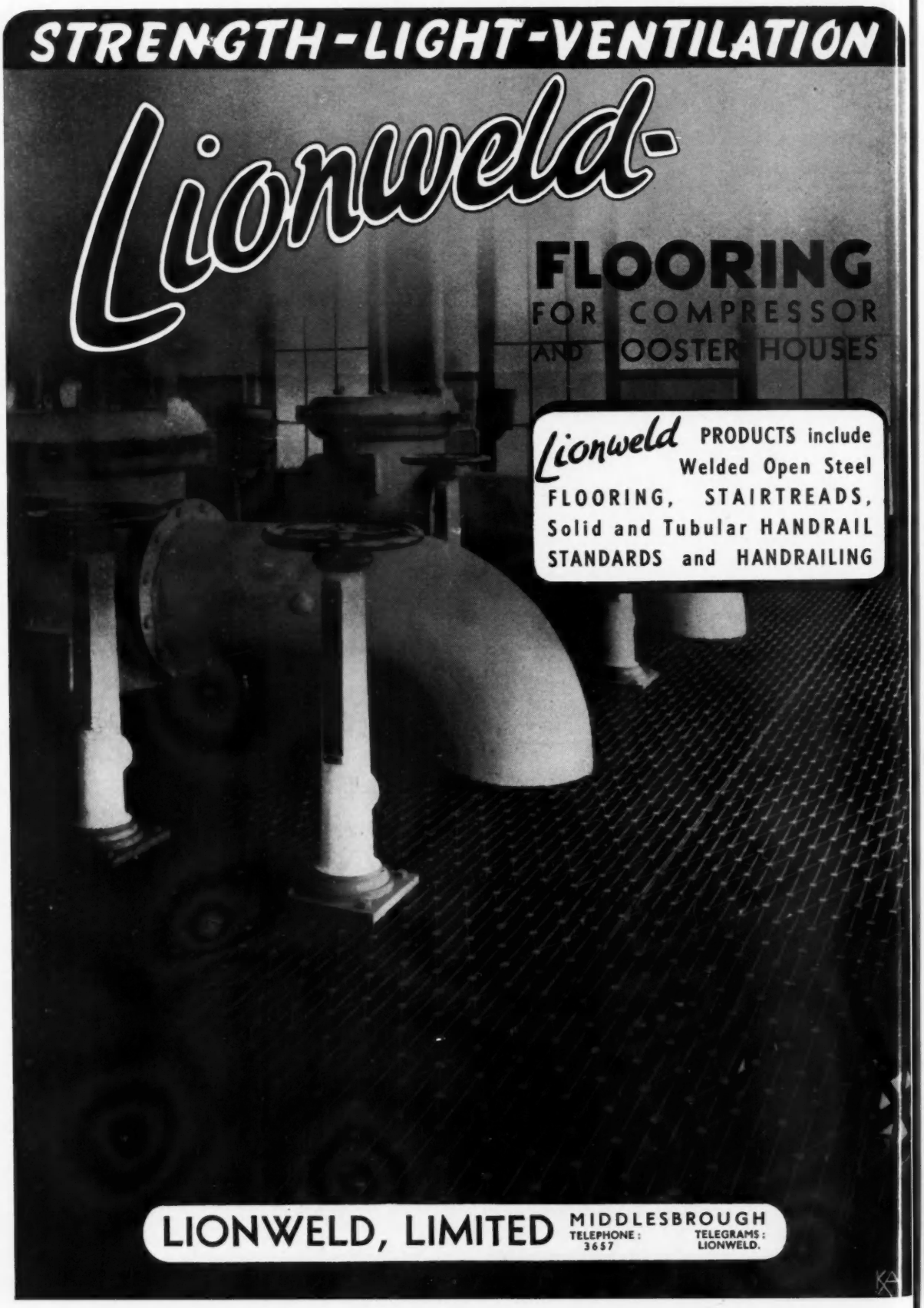
MANCHESTER 10

Telephone : COLlyhurst 2554, 5 & 6
Telegrams : "SCRUBBER, MANCHESTER 10"

London Office : 34 VICTORIA STREET, S.W.1
Telephone : ABBey 4426 Telegrams : "Scrubber, Sowest, London"

Our Works are well equipped and our available services include facilities for stress-relieving our welded products, the thorough examination of welding by means of X-rays, and the use of isotopes for gamma ray testing where necessary.

A


STRENGTH-LIGHT-VENTILATION
Lionweld-
FLOORING
FOR COMPRESSOR
AND BOOSTER HOUSES
Lionweld PRODUCTS include
Welded Open Steel
FLOORING, STAIRTREADS,
Solid and Tubular HANDRAIL
STANDARDS and HANDRAILING
LIONWELD, LIMITED
MIDDLESBROUGH
TELEPHONE: 3657
TELEGRAMS: LIONWELD.

W & W

FOR

MODERN GAS PLANTS

OF EVERY DESCRIPTION

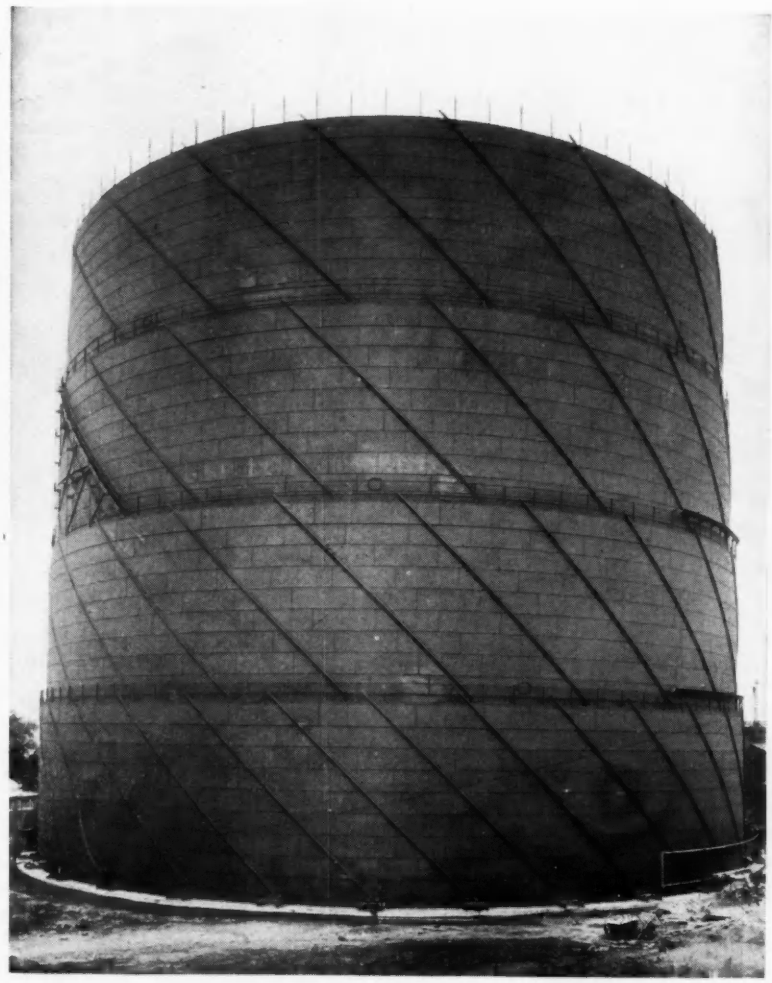
GASHOLDERS

CONDENSERS

GAS VALVES

RETORT BENCH IRONWORK

GENERAL CASTINGS



PURIFIERS

WASHERS

SCRUBBERS

WELDED PIPES & SPECIALS

STRUCTURAL STEELWORK

WESTWOOD AND WRIGHTS LTD.

BRIERLEY HILL, STAFFS

Telephone : BRIERLEY HILL 7751–4

Telegrams : WESTWOOD WRIGHTS

PEART of HYDE

THE PEART (PATENT)
LEADLESS SPLIT COLLAR

PATENT NO. 733220

★ PATENT MOULDED RUBBER JOINTS, RUBBER CONFORMING TO B.S.S. 772.

★ GUARANTEED SEAL WITHOUT USING LEAD

★ EASILY TRANSPORTED.

★ ONE SPANNER ONLY REQUIRED.

★ CAN BE FITTED IN TEN MINUTES.

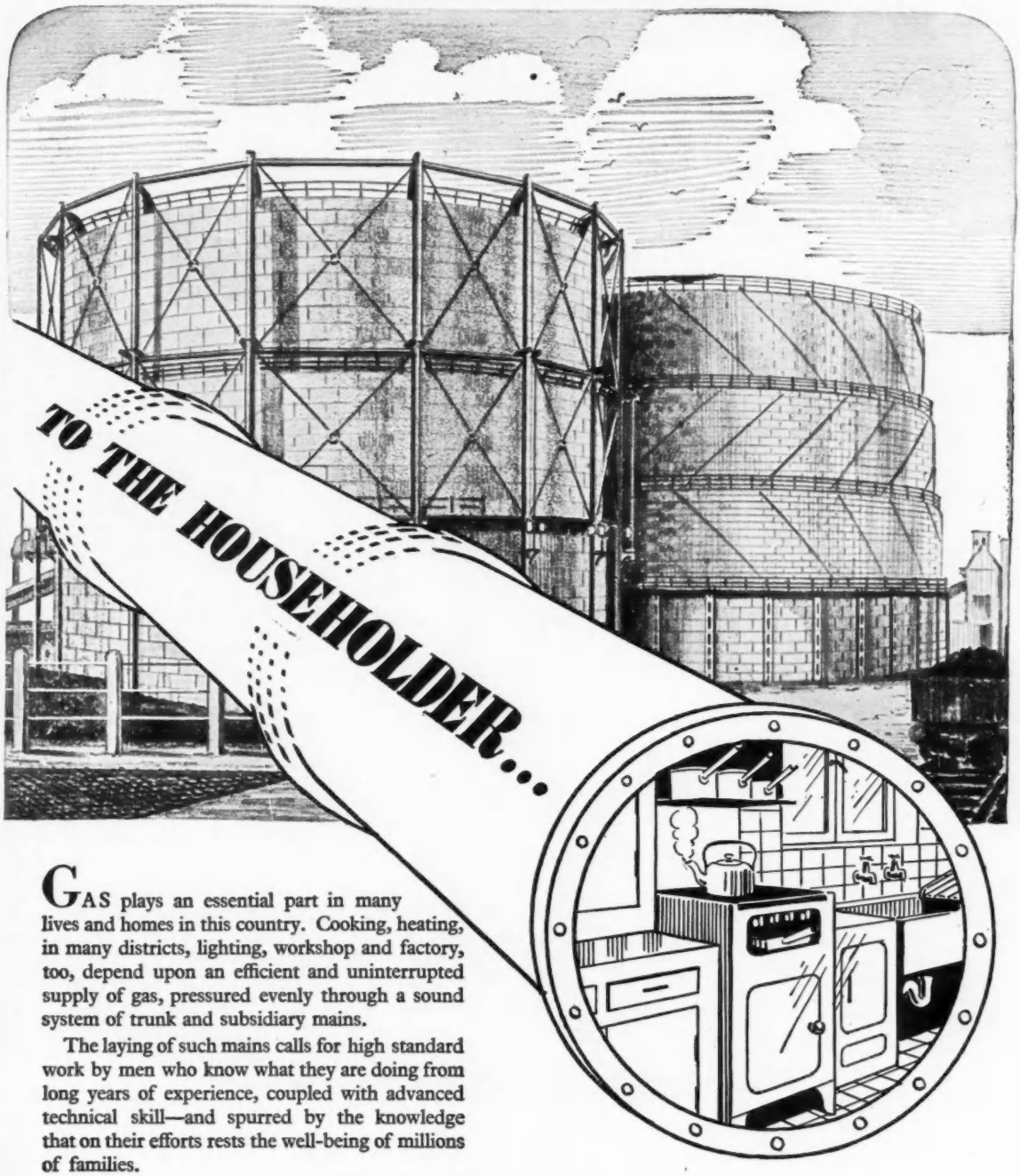
★ CAN BE SUPPLIED WITH OR WITHOUT BOSS.

★ DRILLED AND TAPPED ½"-2" B.S.P. IF REQUIRED.

★ TESTED UP TO 350 lbs. p.s.i. HYDRAULIC PRESSURE.

E. PEART & CO. LTD.
ONWARD WORKS · HYDE · CHESHIRE
TELEPHONE: HYDE 981/2

. . . from the holder



GAS plays an essential part in many lives and homes in this country. Cooking, heating, in many districts, lighting, workshop and factory, too, depend upon an efficient and uninterrupted supply of gas, pressured evenly through a sound system of trunk and subsidiary mains.

The laying of such mains calls for high standard work by men who know what they are doing from long years of experience, coupled with advanced technical skill—and spurred by the knowledge that on their efforts rests the well-being of millions of families.

WE WHITTAKER·ELLIS·LTD

WHITTAKER ELLIS Ltd.

CIVIL ENGINEERING CONTRACTORS

CONTRACTORS TO GAS UNDERTAKINGS

AND

for Service to the Community

52-66 PORTSLADE ROAD, LONDON, S.W.8. Tel.: MACaulay 2451 Grams: Whittakel, Sowest, London.
BIRMINGHAM Belmont Works, Belmont Row, Birmingham, 4. Tel.: Aston Cross 2241/2. Grams: Spigot, Birmingham.
Registered Office: 22/24, Ely Place, London, E.C.1.

W.E. 750

Outstanding in appearance and performance, this versatile modern heating unit is designed for use anywhere in the home where there is an existing fireplace. For modest outlay it provides efficient, economical fireside comfort ON TAP—when and where it is needed most. Dignity in design combined with lustral bronze and gold finish provide an exceptionally attractive appearance, applicable to either traditional or contemporary decor.

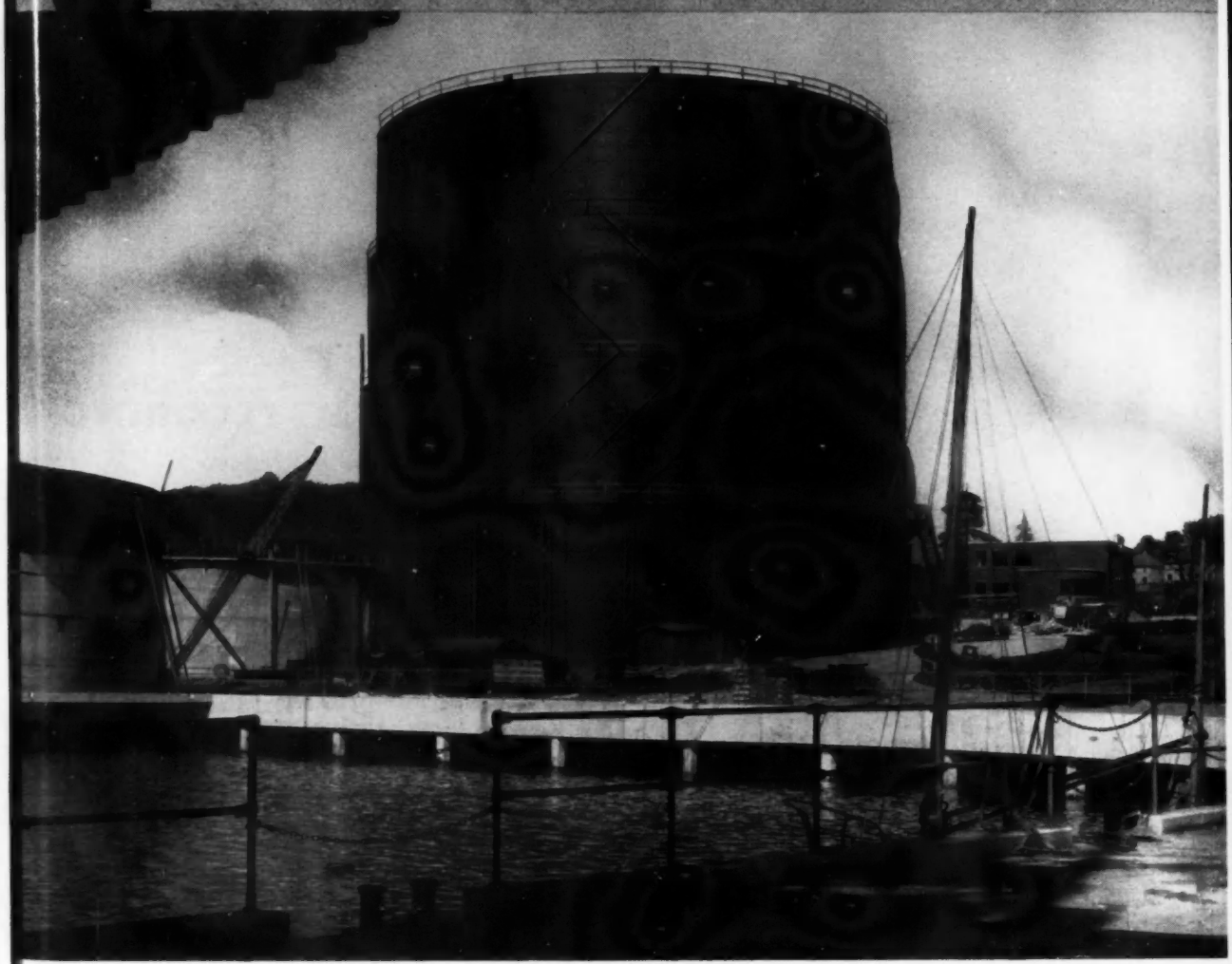
Please write for further details.

WILLIAM SUGG & CO. LTD.
(Inc. Cowper Penfold & Co. Ltd.)

SUGG WESTMINSTER

Vincent Works, Regency St., London, S.W.1
Tele: Victoria 3211

FB Orkneys TO THE Isle of Wight



Photograph by Courtesy of Southern Gas Board.

New three-lift Spiral-Guided "FB" Gasholder in Steel Tank 1,000,000 cu. ft. capacity, provided with "Vulcan" cup and dip stiffeners, "Vulcan" ball-thrust guide carriages having cast steel bodies and grease gun lubrication. Built for the Southern Gas Board at the New Central Gas Works, East Cowes, I.O.W.

Two further Gasholders are shown in the course of erection a double-lift Column-Guided C.W.G. Holder, and a 750,000 cu. ft. three-lift Spiral-Guide Holder of similar design to the 1,000,000 cu. ft. Holder just completed.

ILLUSTRATED BROCHURE MAILED ON REQUEST

FIRTH BLAKELEY SONS & COMPANY LTD.

GAS, CHEMICAL AND CONSTRUCTIONAL ENGINEERS

VULCAN IRONWORKS · CHURCH FENTON · YORKSHIRE

Telephone: Barkston Ash 234/5

Telegrams: Blakeleys, Church Fenton.

MATERIALS HANDLING
FISHOLOW
SERVICE TO INDUSTRY

A FIRM FOOTING WITH...

FLOWFORGE

OPEN STEEL FLOORING

FIRST ON ALL POINTS

★ Electrically forge-welded.
★ Exceptional strength to weight ratio.
★ Large panels, up to 20′ x 3′.
★ Twisted crossbars provide a non-slip surface.
★ Maximum Light-passing and ventilating capacity.
★ Easy to paint and keep clean.
★ All joints solid.

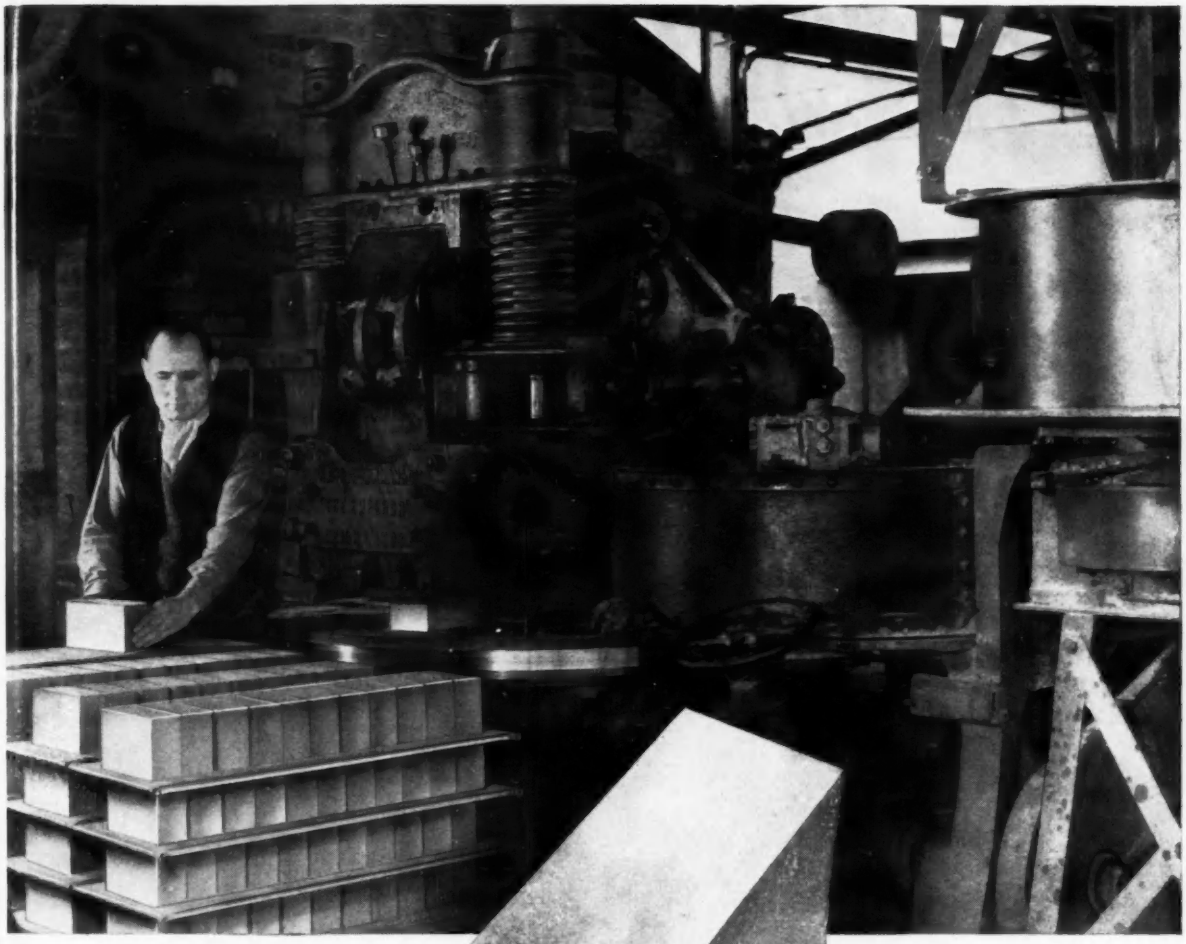
AVAILABLE FROM STOCK

Publication No. 181 gives full details

Fisher & Ludlow Ltd

MATERIAL HANDLING DIVISION · BORDESLEY WORKS · BIRMINGHAM · 12 Tel: VICtoria 2371

Also at: London · Manchester · Cardiff · Glasgow · Newcastle-on-Tyne · Bristol · Belfast & Dublin



Automatic Press producing Silica squares.

Background to a Quality Production

The reputation enjoyed by Gibbons Refractories in the industrial world today depends upon the soundness of the up-to-date methods of their production—the results of a hundred years' experience in the manufacture and development of furnace linings and firebricks of all kinds for many purposes.

H.T.1. · ALUMINOUS · SILICA · FIREBRICK · SILLIMANITE

GIBBONS superior refractories

Gibbons (Dudley) Ltd., Dibdale Works, Dudley, Worcs.

50 YEARS SERVICE

to the CARBONISING INDUSTRY...

MELTHAM

SILICA SHAPES AND BRICKS

LOW THERMAL EXPANSION · TRUE TO SHAPE AND SIZE
HIGH RESISTANCE TO ABRASION · FIRST CLASS FINISH

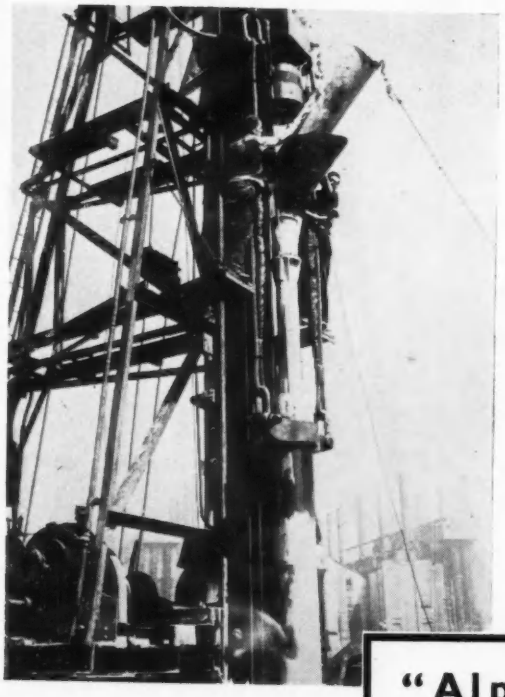
THE MELTHAM SILICA FIREBRICK CO. LTD.

MELTHAM, NR. HUDDERSFIELD · TEL. MELTHAM 321 · GRAMS. REFRACTORY MELTHAM

104

CONCRETE in 1955

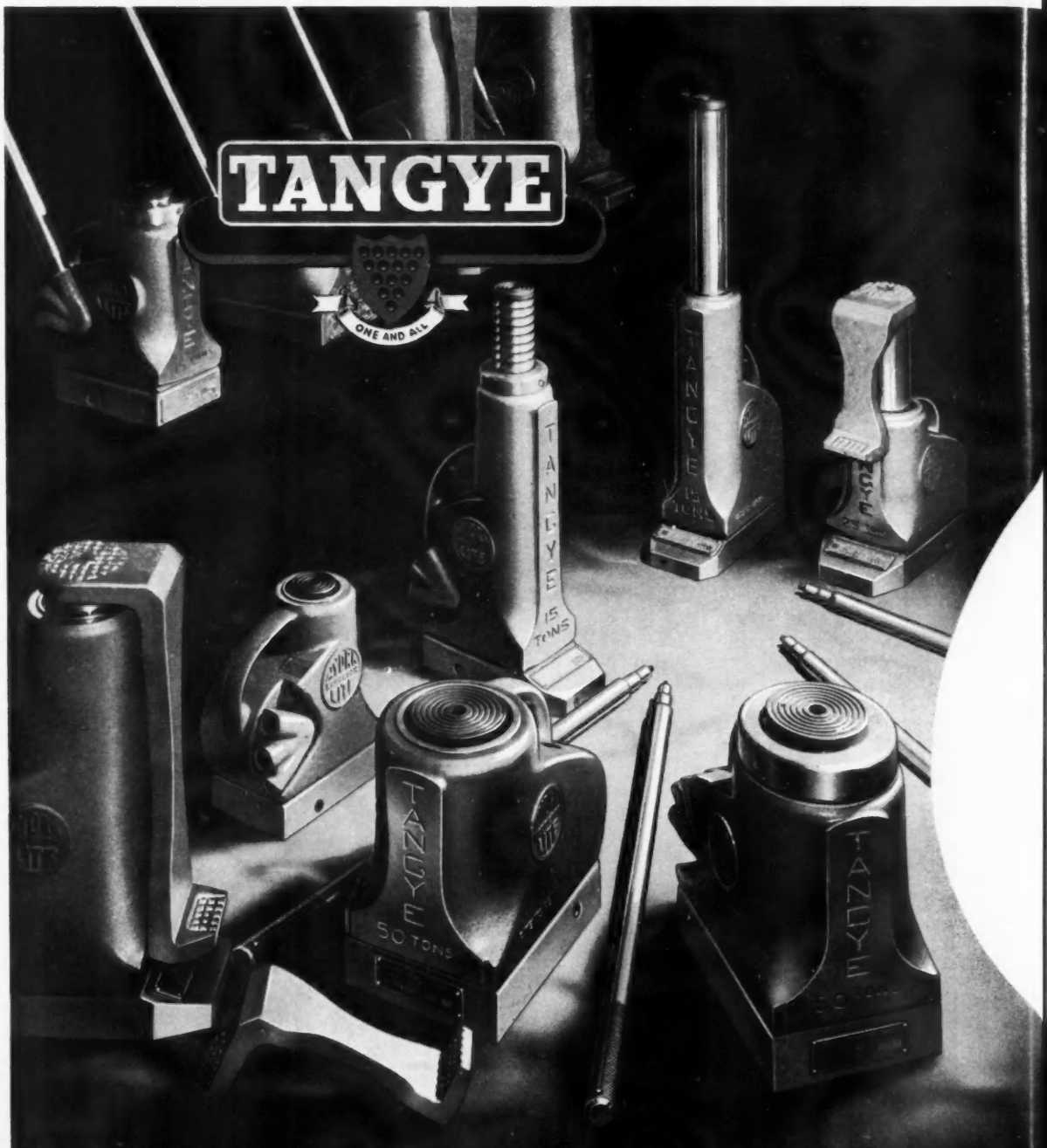
During 1955, F.C.C.'s experience and ability have been used extensively throughout the country. The same specialist service is available in 1956



- *REINFORCED, PRESTRESSED, AND PRECAST CONCRETE.*
- *PRECAST AND IN-SITU PILING.*

"Alpha" Piling System—
—Sole British Licensees.

F.C. CONSTRUCTION CO. LTD.
CITY ROAD DERBY



THE RANGE OF TANGYE 'HYDRALITE' JACKS

MODEL No.	CAPACITY IN TONS		POWER LIFT (inches)	CLOSED HEIGHT STANDARD JACK (inches)	CLOSED HEIGHT RAM LOCKING TYPE (inches)	WEIGHT OF JACK (lbs.)	WEIGHT OF CLAW (lbs.)	MIN CLAW HEIGHT (inches)
	BRIT. (2,240 lbs.)	U.S.A. (2,000 lbs.)						
6515	15	16·5	6½	10⅛	11⅞	24	—	—
6515C	15	16·5	6½	10⅛	11⅞	24	8	2⅜
625	25	27·5	6	10⅛	11½	32	—	—
625C	25	27·5	6	10⅛	11½	32	12	2⅞
650	50	55	6	11½	13	61	—	—
1215	15	16·5	12	17½	18½	38	12	2⅜
1225	25	27·5	12	17⅞	18⅞	53	13	2⅞

AD:26

These truly lightweight Jacks are successful in all fields.

HYDRA LITE

BUILDING INDUSTRY

"DON'T KNOW HOW we managed without them" is an opinion often expressed to our representatives by the men who actually use the Hydralite hydraulic jacks. When we consider that it takes two or more people to lift an old-fashioned jack of, say, 25 tons capacity but that a Hydralite can be lifted easily by one hand, we soon appreciate why the men prefer them.

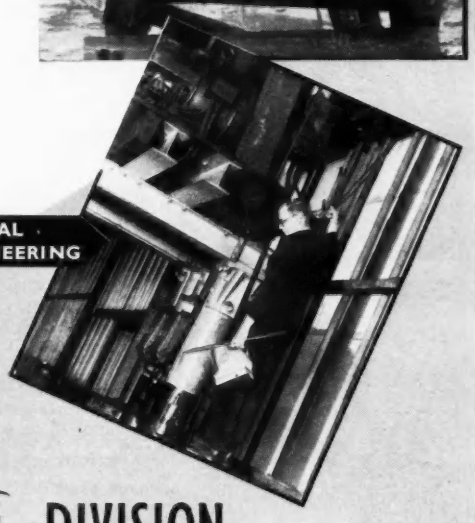
For example, the top illustration shows one of a number of giant roof-beams 60 ft. long and weighing 5 tons which were lifted in stages into position from ground level. So much positioning of high-tonnage jacks in this job made the Hydralite an invaluable tool.

Construction of a Bailey Bridge, shown in the second picture, requires Jacks at every stage and Thomas Storey Limited, who have the sole manufacturing rights of the bridge for civilian use, use Tangye Hydralites.

The uses for Hydralites in all Engineering works are manifold and the saving of time and labour off-sets their cost in a few months.

CIVIL ENGINEERING

GENERAL ENGINEERING



Send Today
for catalogue and further information

TANGYE HYDRAULIC DIVISION

A century of Hydraulic experience

CORNWALL WORKS SMETHWICK BIRMINGHAM

BRANCH HOUSES AT LONDON MANCHESTER NEWCASTLE GLASGOW

"BIG BEN" . . . named after Sir Benjamin Hall . . . has been a symbol of regularity since 1859. So, in their own sphere, are A. & M. Meters . . .

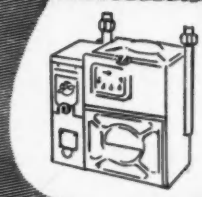
'In the picture' with A. & M.

It's trouble-free running that does it!

Trouble-free running is indeed an outstanding feature of the current series A. & M. Meters with the "S" Mechanism. Sound design, robust construction, precise assembly and rigid inspection all add up to a new standard of trouble-free operation.

The illustration shows the A. & M. .1 c.ft. Wet Leakage Meter, accurate to .1 c.ft. plus or minus.

THE MINIMETER is the famous SMALL SCOTCH that gives Trouble-Free Running in most compact form



ALDER & MACKAY LTD
GAS METER & INSTRUMENT MAKERS

NEW GRANGE WORKS, EDINBURGH, 11, and at London and Manchester.

UGI GROUP

THERMIC

1. Aluminium Bale Out Furnace
2. Cyanide and Preheating Pot Furnace
3. Gas Fired Semi-Muffle Furnace
4. Gas Fired Studio Pottery Kiln
5. Oil Fired Forge Furnace
6. Cyclone Forge and Reheating Furnace
7. High Speed Section Heating Furnace
8. Double Deck High Speed Steel Tool Furnace
9. Tilting Crucible Furnace
10. Oil Fired Rotary Melting Furnace
11. Portable Rivet Heating Furnace
12. Gas Fired Rotary Hearth Furnace
13. Eddy Flame Oil Burner
14. Vertical Forced Air Circulation Furnace
15. Eddy Ray Gas Burner
16. Gas Fired Saltbath Furnace

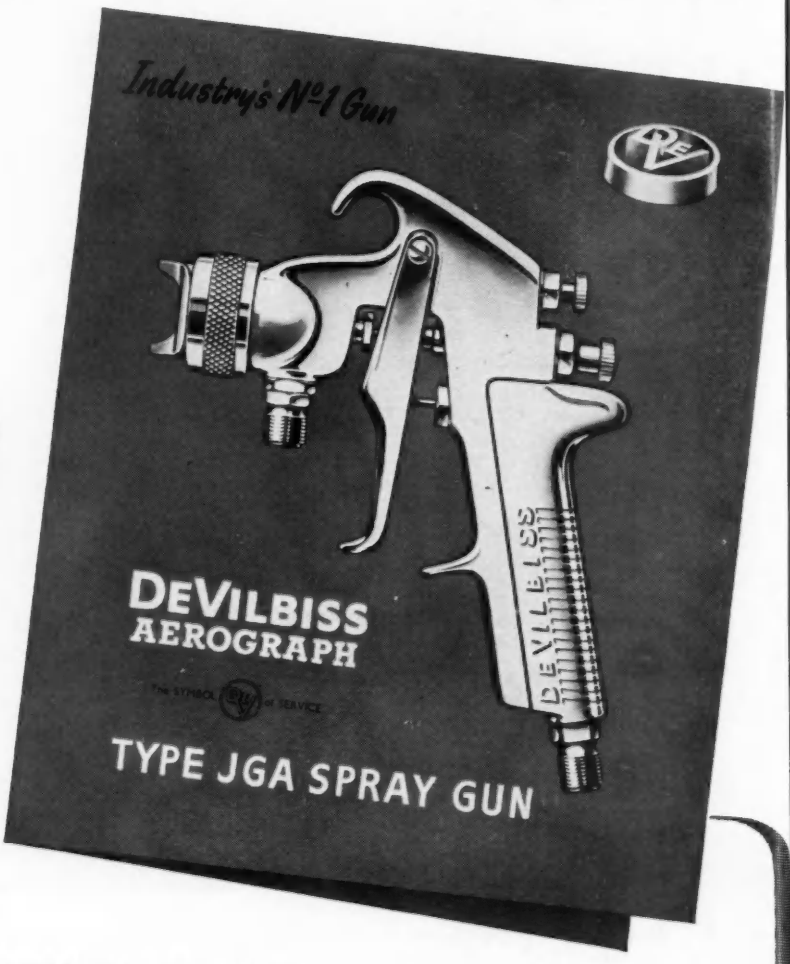
We offer a wide range of special Furnaces, "tailor made" to individual requirements

Thermic Equipment & Engineering Co. Ltd.,

(Subsidiary Company of Gibbons Bros. Limited, Dudley)

SALMON STREET, PRESTON · *TELEPHONE: PRESTON 56254/5* · *TELEGRAMS: THERMIC-PRESTON*

The first step towards Quicker quality finishing



Write for this JGA folder today

It tells why the JGA is industry's No. 1 Gun and how it eliminates bottlenecks in mass production. Ask for folder AY. 20.

The SYMBOL of SERVICE

DEVILBISS AEROGRAPH

Sets the pace in spraying

The Aerograph Co. Ltd. (Sales Division) 47 Holborn Viaduct London EC1 · CITy 4361

Branches : Birmingham · Bristol · Glasgow · Manchester · Factory at Lower Sydenham SE26

For efficient and lasting service....

To burn gas efficiently for the production of hot water, either for domestic purposes or central heating, demands a Boiler specially designed for the purpose. Over a period of 20 years we have developed a series of Boilers, each of which is unequalled in its particular field.

All Boilers are equipped with a complete set of thermostatic controls, and have insulated jackets of enamelled steel or aluminium in appropriate finishes. 'Ideal' Gas Boilers, of which several thousands a year are being installed, are available in 22 sizes from 20,000 to 1,430,000 B.T.U. per hour. *An illustrated booklet giving full details is available on request.*

In the current models of the No. 1-GBC series, the gas controlling instruments are protected by a neat removable stove enamelled cover.

IDEAL GAS BOILERS

RELIABLE AND LABOUR-SAVING

IDEAL-Standard

Foremost for heating and sanitary equipment

IDEAL BOILERS & RADIATORS LIMITED · IDEAL WORKS · HULL

295

B

The Ocean-going ship that sails through a meadow

On April 7 the s.s. " Manchester Pioneer " left the port of Manchester via the Ship Canal to make her regular crossing of the Atlantic. As with most other sailings of her Line, she carried in her hold a large consignment of Parkinson Gas Meters destined for service in Eastern Canada.

The now well-known Parkinson ' Double Century ' Meter is not only purchased in quantity by every Area Board of the Nationalised Gas Industry at home, and by Gas Undertakings in Northern Ireland but large numbers also find their way to Gas Undertakings in the Americas, Australasia, South Africa and the East.

PARKINSON AND COWAN GAS METERS

in association with

PARKINSON & COWAN GROUP EXPORTS LIMITED

From the Earliest Days

First Parachute Display
In 1837 one Cocking made the first descent from a balloon.

Pioneers in the making of Cast Iron pipes for gas mains for over a hundred years—Staveley has kept in step with the ever growing Gas Industry and its mains distribution network.

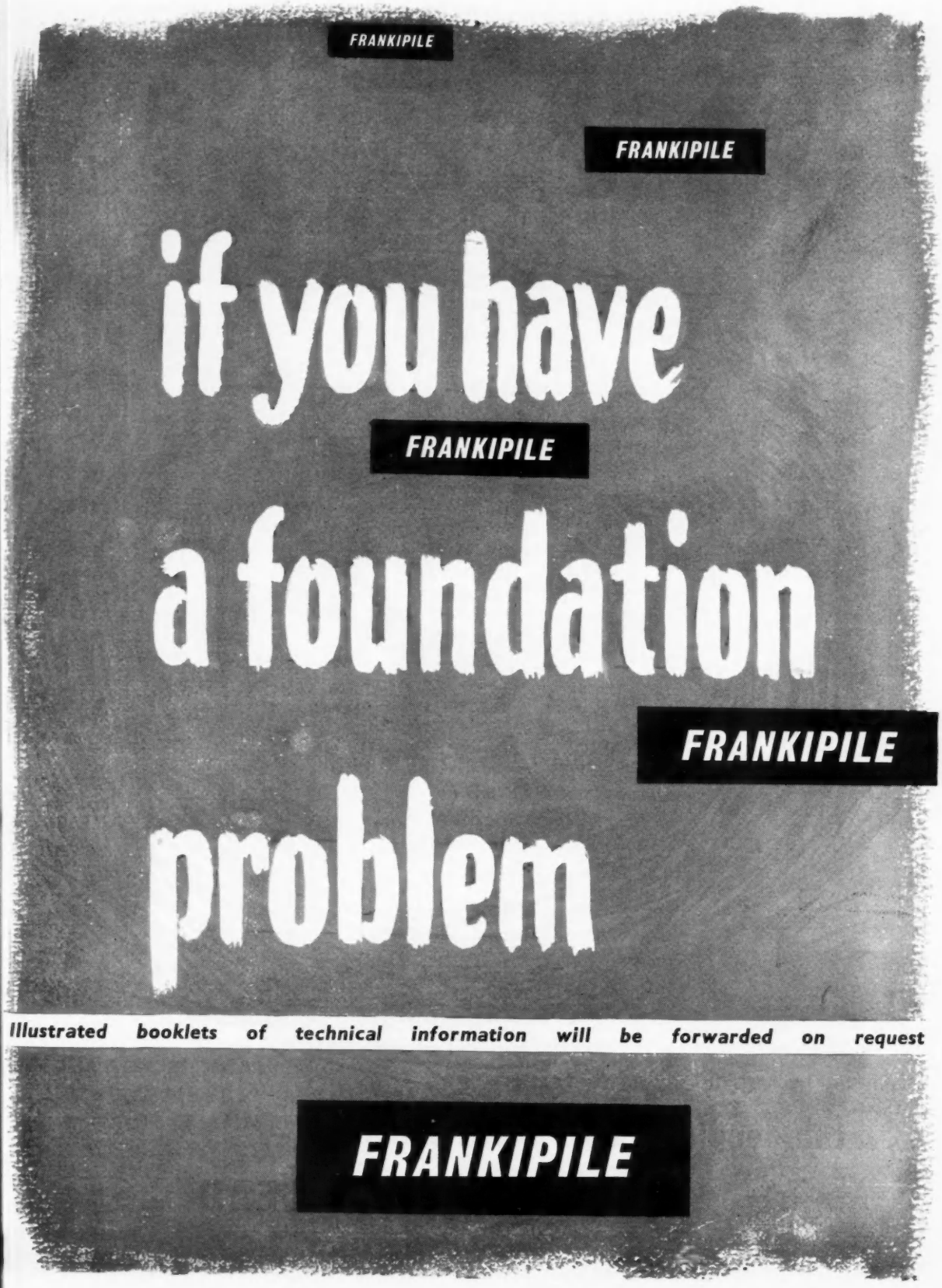
The Staveley Screw-Gland Flexible Joint is now being supplied with pipes of 3 in. to 6 in. diameters inclusive. The Bolt Type Joint is used on diameters of 7 in. and over.

The famous Staveley flexible joints allow up to four degrees of movement and are standard with most Gas Authorities the world over.

STAVELEY

SAND & METAL SPUN PIPES *for* **GAS MAINS**

THE STAVELEY IRON & CHEMICAL CO. LTD. NR. CHESTERFIELD



THE FRANKI COMPRESSED PILE CO. LTD. · 39 VICTORIA ST LONDON SW1 · CABLES · FRANKIPILE SOWEST LONDON

AND IN AUSTRALASIA · BRITISH WEST INDIES · IRAQ · RHODESIA · S. AFRICA

If you use any of these...
LEAD GAS PIPES. SOLDER
LEAD ALLOY GAS PIPES
GENUINE WHITE LEAD PAINTS
WHITE LEAD BASE PAINTS Hard Gloss and Oil Gloss
CHEMICAL LEAD including SILVER COPPER CHEMICAL LEAD
WHITE LEAD OR RED LEAD Ground in Oil
RED LEAD PAINTS. LIQUID RED LEAD
CALCIUM PLUMBATE PAINTS

...the people to ask about them are–

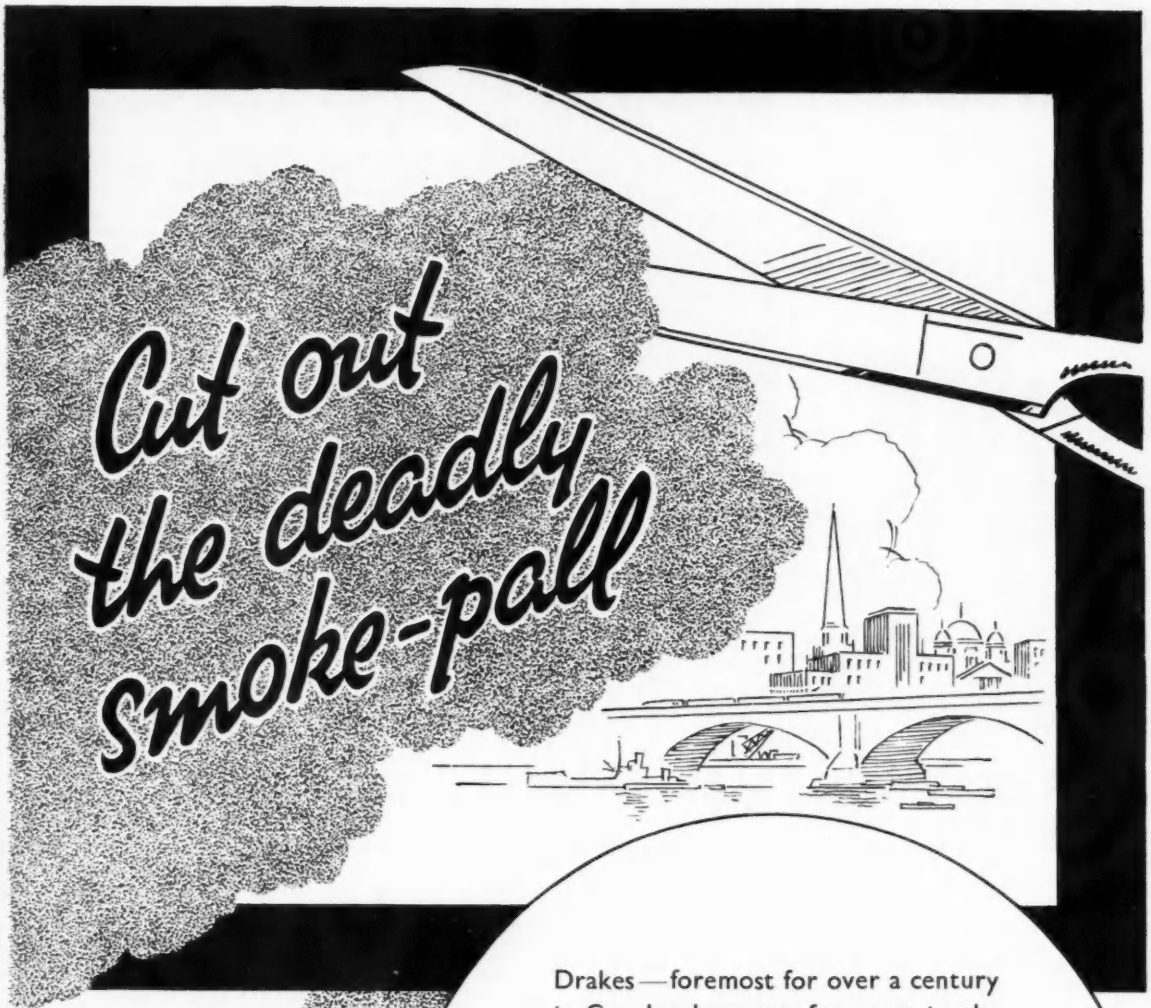
ASSOCIATED LEAD

MANUFACTURERS LIMITED

ASSOCIATED LEAD PRODUCTS

IBEX HOUSE, MINORIES, LONDON, E.C.3 · CRESCENT HOUSE, NEWCASTLE · LEAD WORKS LANE, CHESTER

EXPORT ENQUIRIES TO: THE ASSOCIATED LEAD MANUFACTURERS EXPORT CO. LTD., IBEX HOUSE, MINORIES, LONDON, E.C.3



Drakes—foremost for over a century in Gas development; foremost in the national drive for smoke abatement, and proud to remain in the service of GAS—the cleanest fuel in the world.

DRAKES of HALIFAX

CONSTRUCTIONAL GAS ENGINEERS FOR MORE THAN A CENTURY

TELEPHONE: HALIFAX 4701 P.B.Ex. TELEGRAMS: DRAKEFAX, HALIFAX

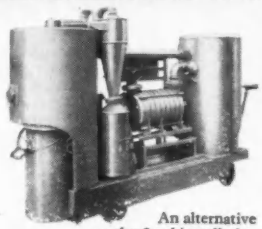
J.J.M.

DUST and HOT ASH REMOVAL by B.V.C

"BRITISH VACUUM CLEANER"

INSTALLATION

The illustration shows a typical B.V.C. installation in operation. Cleaning hoses can be coupled to installed piping throughout the works and all dust and ash collected at a central station for disposal. Hot ash can be handled and special non-choking tools are supplied to handle large volumes of ash.

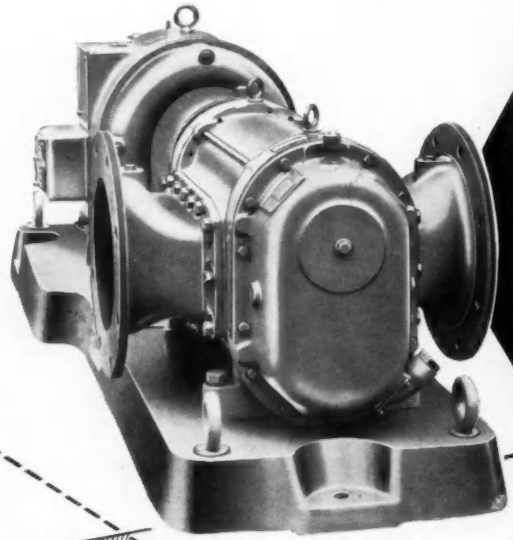


An alternative to the fixed installation is the B V C. portable heavy duty plant.

Please write for particulars

THE BRITISH VACUUM CLEANER & ENGINEERING CO. LTD

Dept. 63, Goblin Works, Leatherhead, Surrey



Oil free gas boosting

Godfrey gas boosters are suitable for handling mos commercially used gases including town's gas . . . positive sealing ensures freedom from oil contaminatio

GODFREY
SIR GEORGE GODFREY & PARTNERS (1940) LTD.

SIR GEORGE GODFREY & PARTNERS (Industrial) LT

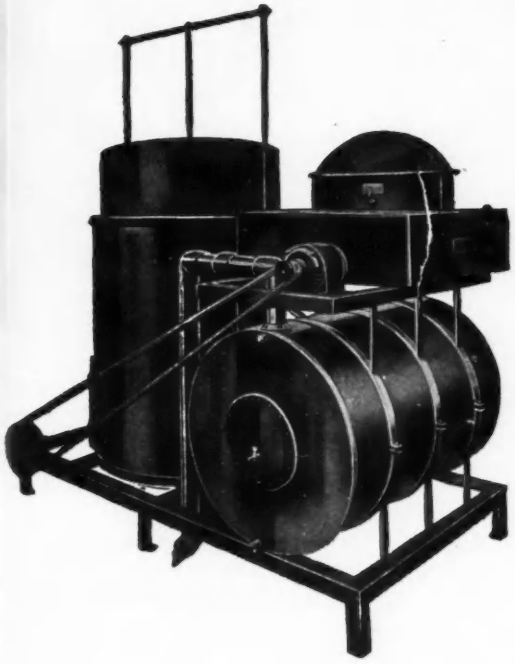
HANWORTH, MIDDLESEX

TELEPHONE: FELTHAM 3291 CABLES: GODFREPART, LOND

ASSOCIATED COMPANIES IN CANADA, AUSTRALIA & SOUTH AFRI

AEROGEN GAS GENERATORS

(300 B.T.U's per cubic foot)



Single unit capacities range from 100 to 15,000 cu. ft. of Petrol Air Gas supply per hour. One gallon of petrol produces 500 cu. ft.

The Ideal fool-proof system in commission in thousands of laboratories, industrial processing works, etc., at home and abroad where Town's Gas Supply is not readily available.

Conventional Appliances are easily adapted to coal gas burner performance.

Full technical information obtainable from the makers :

THE AEROGEN COMPANY LTD.
ANSTEY MILL LANE WORKS,
ALTON, HAMPSHIRE, ENGLAND
(Established over half a century)

Telegrams : Aerogen, Alton, Hants. *Telephone : Alton 2081*

EB

Welding . . . .
Gunning . . . .
Spraying . . . .
of GAS RETORTS

Write for particulars of how "E. B." Service can help in reducing maintenance costs.
Manufacturers of all types of Cements.

E. B. REFRACTORY CEMENT CO. LTD.
OAKFIELD OFFICES
BRETTELL LANE
STOURBRIDGE

"George was right when we left!"

MAINTAINED ACCURACY

The measurement of a gas flow is an exact science, and the maintained accuracy of the meter depends upon the mechanical excellence of its construction. Revenue losses from inaccurate metering rise directly with the rising cost of coal to the gas works. So it is that dependable meters and a reliable repair service become increasingly important to the Area Gas Board and its customers.

BY ROBINSON'S METERS

All pre-payment meters are fitted with the World-renowned "Smith's Mechanism"

UGI GROUP

J. H. Robinson & Co. (Liverpool) Ltd

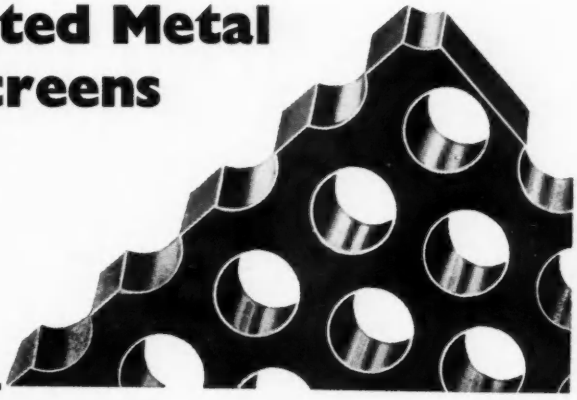
Mill Lane · Old Swan · Liverpool 13

For Gruelling Service

For over seventy years, Harveys have been making Perforated Metal and Wirework for every conceivable purpose, in every kind of metal. 'Harco' Screens are designed to give maximum output over prolonged periods and under the most exacting conditions.

'Harco' Perforated Metal & Wirework Screens

Send for Catalogues Nos. GT 269 and 926.

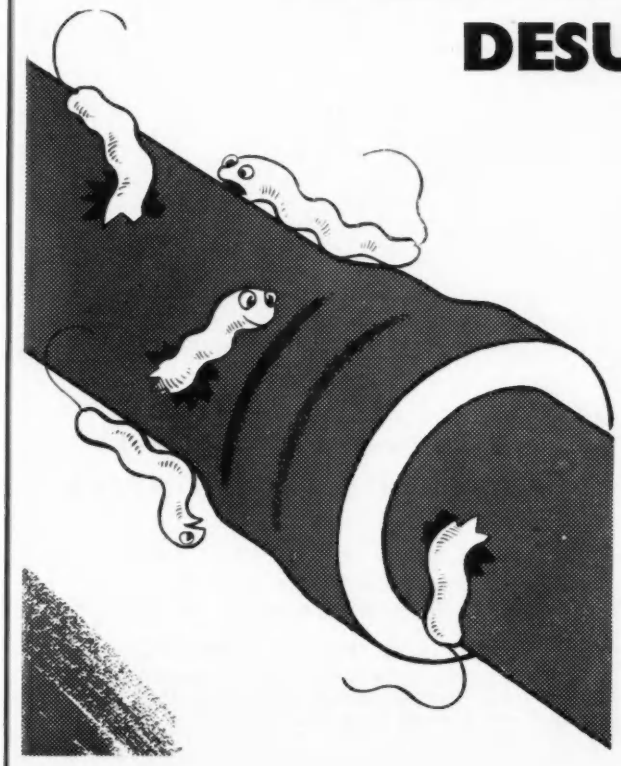


Harvey G. A. HARVEY & Co. (LONDON) LTD.,
Woolwich Road, London, S.E.7.
Telephone: GREenwich 3232 (22 lines)

---

are DESULPHOVIBRIO DESULPHURICANS

eating your steelwork ?



Well, we know they don't literally eat steelwork, but it's a recognised fact that these horrible little bacteria are responsible for the majority of underground corrosion.

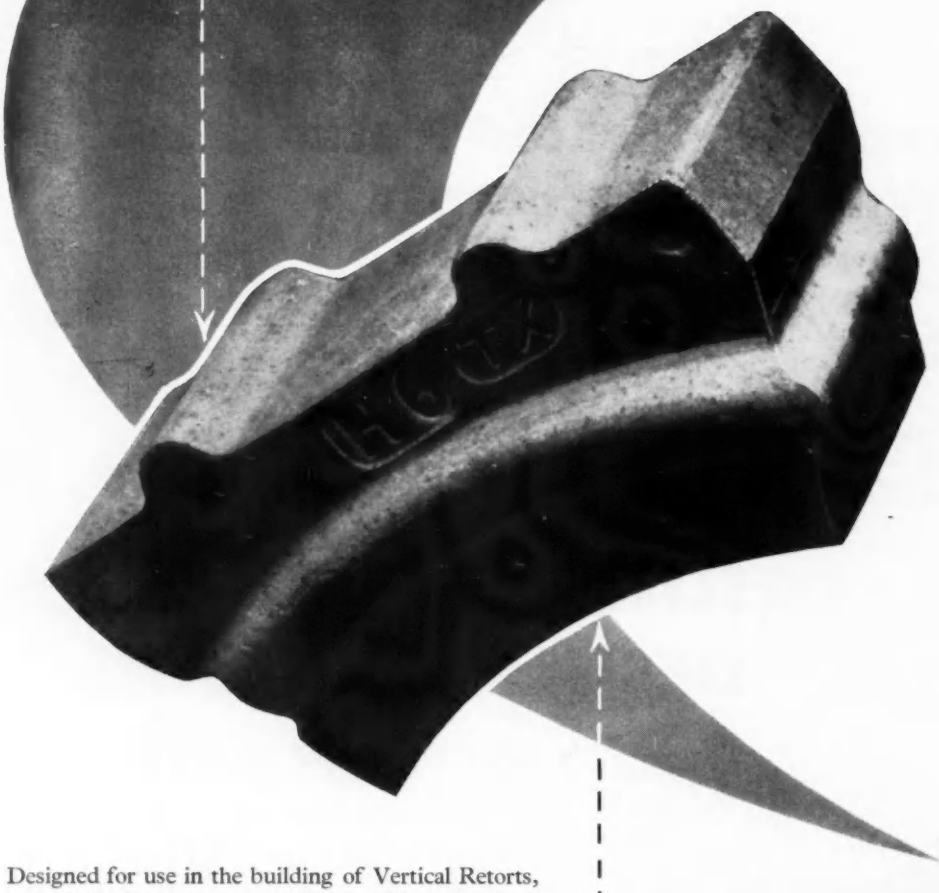
It has recently been established that TANNINS are one of the most effective ways of rendering them inactive. After considerable experiment and testing, we have found a suitable method of incorporating the most effective tannins in our DENSO TAPES, and so greatly increasing their already considerable value in the fight against corrosion.

DENSO REGD. ANTI-CORROSION PRODUCTS
TRADE MARK

Write for further details to :

WINN & COALES LTD.
DENSO HOUSE, CHAPEL ROAD, LONDON, S.E.27
Telephone : GIPsy Hill 4247 (3 lines)

Introducing



Designed for use in the building of Vertical Retorts, "THERMAX" bricks differ considerably from other clay-bonded siliceous materials by reason of their much higher bulk density with lower porosity and permeability. These improvements have been obtained by modification of composition and grading, by the development of a special pressing technique. A continuous and accurate control of the density is kept throughout the process. The result is a retort brick giving reduced slag erosion and flaking which permits retorts to be built and operated without joint leakages.

"THERMAX"

THE NEW CONTROLLED-DENSITY SILICEOUS RETORT BRICK

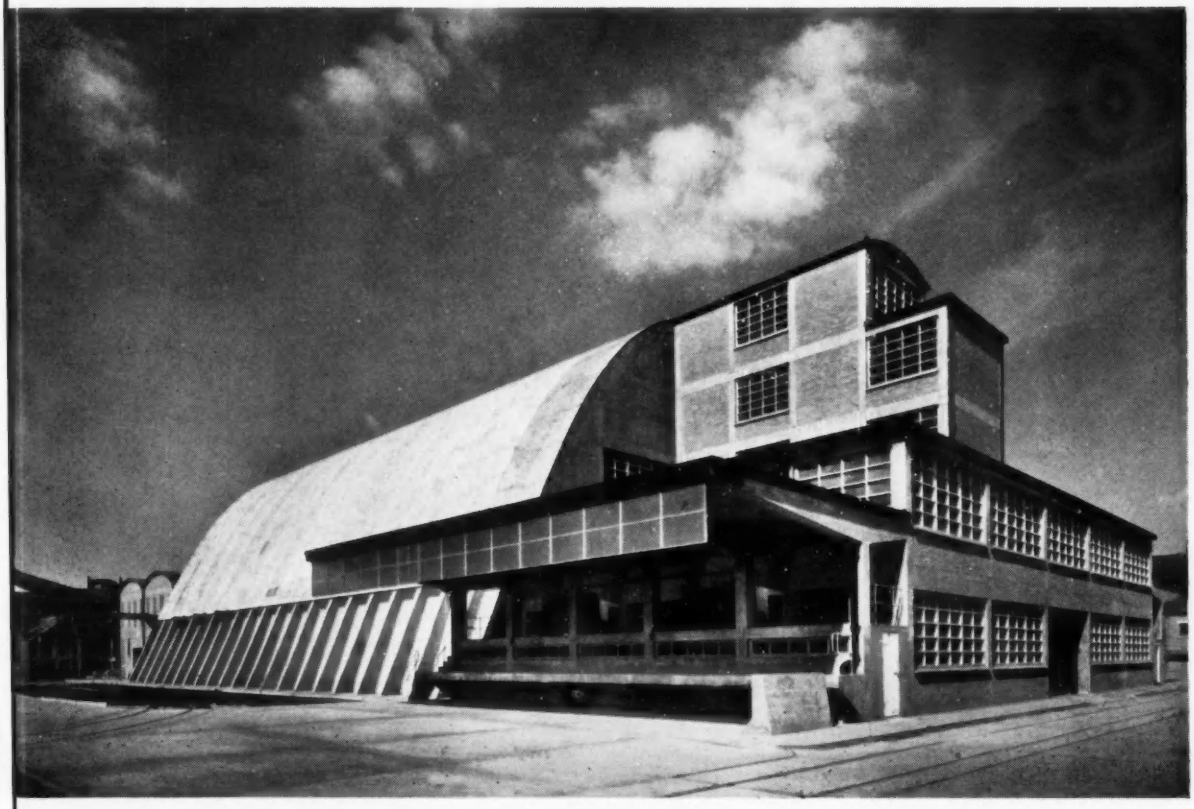
Full technical information will be forwarded gladly on request

DERBYSHIRE SILICA FIREBRICK CO. LTD
FRIDEN . HARTINGTON . NEAR BUXTON . DERBYSHIRE
GRAMS : SILICA, FRIDEN, HARTINGTON
PHONE : YOULGRAVE 271 (3 LINES)

3 ST. JAMES'S SQ. S.W.1 D&C TRAFALGAR 7833

THE
DEMOLITION & CONSTRUCTION
COMPANY LIMITED

CIVIL ENGINEERING, BUILDING AND PUBLIC WORKS CONTRACTORS



A store for 10,000 tons of Sulphate of Ammonia, completed for the South Eastern Gas Board at their Phœnix Wharf Chemical Works, Greenwich.

Construction is of Precast 3 Hinged Arches, the constituent Rib members being Post-tensioned, Prestressed concrete, weighing over 10 tons. The roof panelling is of Pretensioned, Prestressed concrete planks, three inches thick.

ALL TYPES OF CIVIL ENGINEERING, BUILDING AND DISMANTLING WORKS CARRIED OUT FOR GAS UNDERTAKINGS

FWS

C1

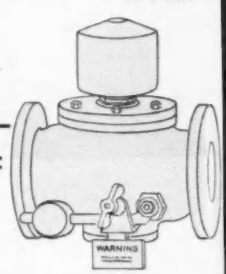
ON THE SUBJECT OF

CONTROL

-we're happy to share our knowledge!

For we have accumulated quite a store of knowledge in over 25 years as valve manufacturers. Magnetic Valves can help you in your control problem, automatic or remote, for air, oil, steam, coal gas, and many other industrial liquids and gases. And the way Magnetic Valves do it, glands, stuffing-boxes, and -driving-shafts are unnecessary. Let us share our knowledge by sending you our illustrated literature, containing details of all Magnetic Valves up to 12 inch orifice.

SPECIAL VALVES DESIGNED *if required*
STANDARD VALVES DELIVERED *ex stock*



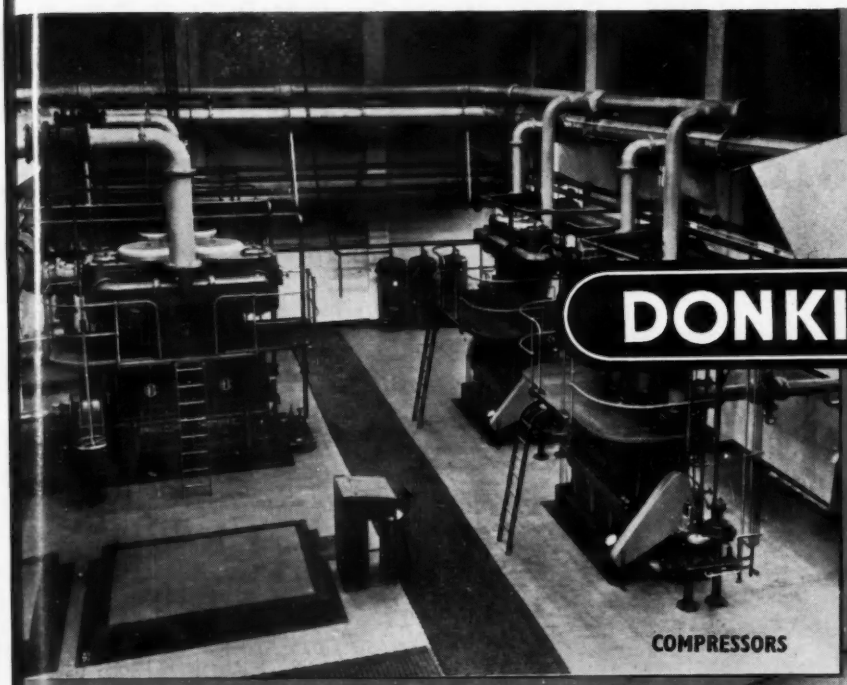
THE MAGNETIC SAFETY CUT-OUT GAS VALVE

The Magnetic Safety Cut-out Gas Valve is of the semi-automatic hand opening electrically maintained pattern, ensuring instantaneous and complete closure in the event of current interruption. The valve is of "packless" construction, and can be supplied in sizes ranging from ¼" up to and including 12".
Alternative types of hand operating gear are available including hand lever, weight return, and push-up spring return patterns.
The installation of this valve is an essential precaution with all types of gas fired equipment and ensures complete isolation of the gas supply in the event of an interruption of the electrical supply WITHOUT automatic opening when such electrical supply is restored.

The magnetic valve co. LIMITED

28 ST. JAMES'S PLACE, LONDON, S.W.1.

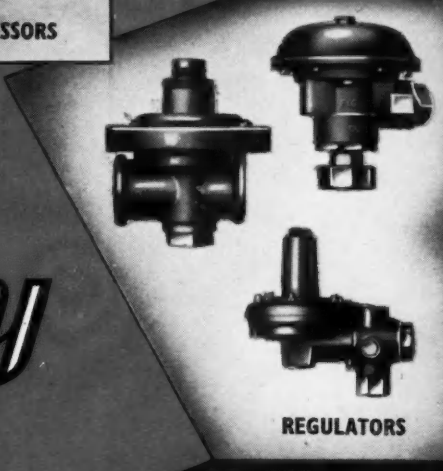
***Telephone*: HYDe Park 7588**



DONKIN

COMPRESSORS

VALVES



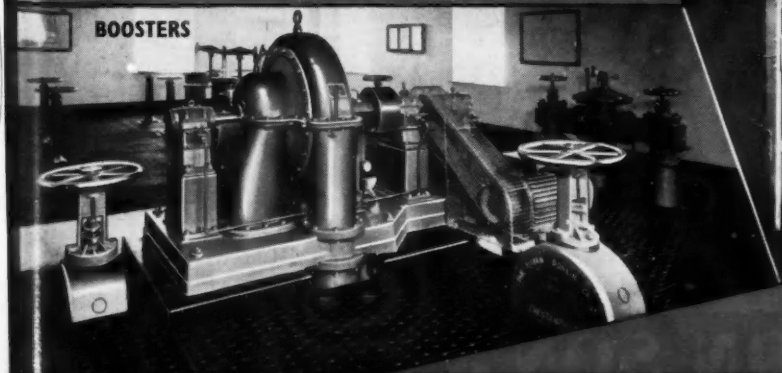
REGULATORS

Serving Industry

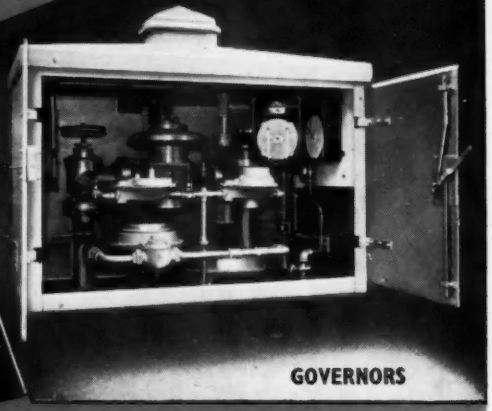
Millions of cubic feet of gas are used daily in factories and homes throughout the country.

The comprehensive nature of DONKIN equipment is such as to cover every phase of gas distribution and control.

Over 150 years experience, sound engineering practice and design together with first class workmanship have proved the reliability of DONKIN products which are well known in many parts of the world.



BOOSTERS



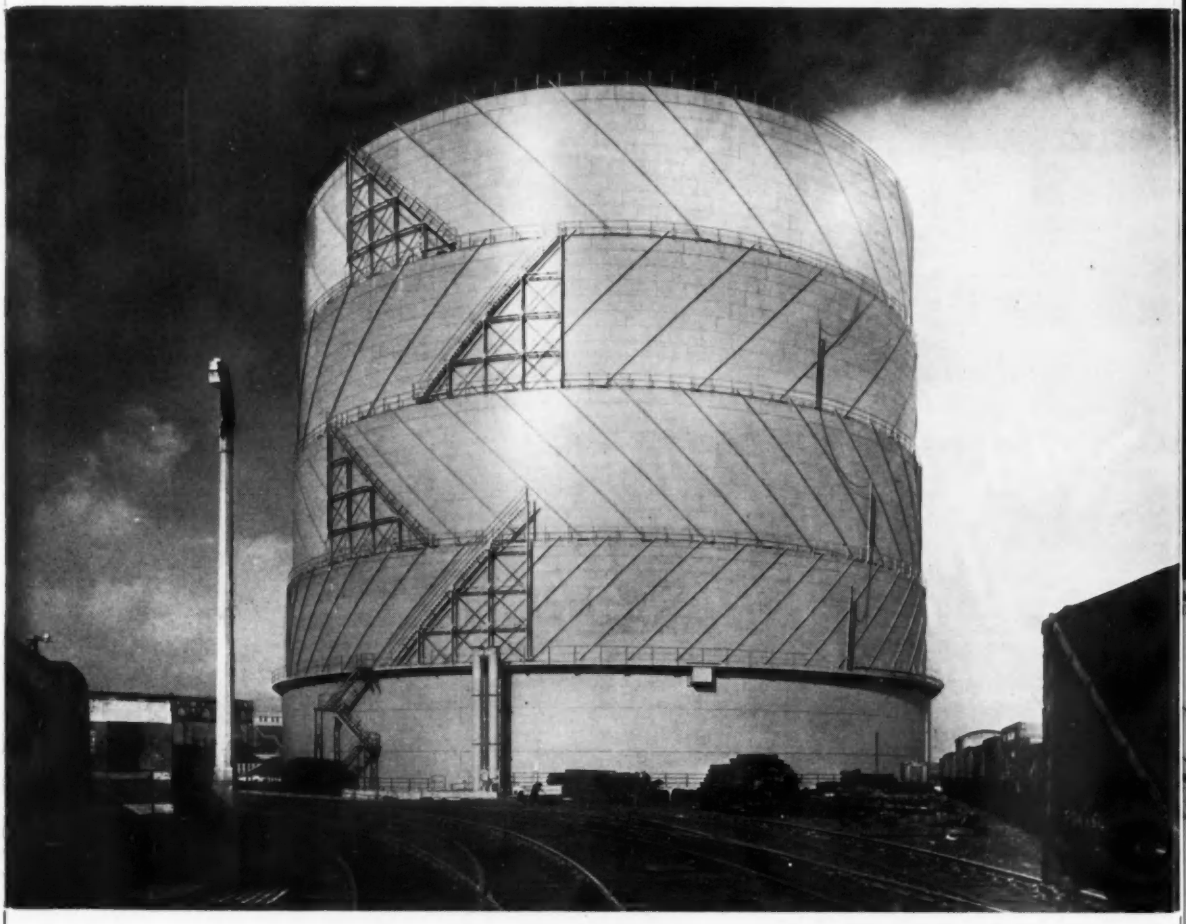
GOVERNORS

THE BRYAN DONKIN Co. LTD. CHESTERFIELD

FIVE MILLION

CUBIC FEET CAPACITY

GASHOLDER and STEEL TANK



COMPLETED MAY 1953 AT

SWAN VILLAGE GASWORKS

BIRMINGHAM DIVISION, WEST MIDLANDS GAS BOARD

CLAYTON SON & CO. LTD.
HUNSLET LEEDS YORKSHIRE

120 TONS COAL PER HOUR STACKED 12 FT. HIGH with a BIG WALRUS

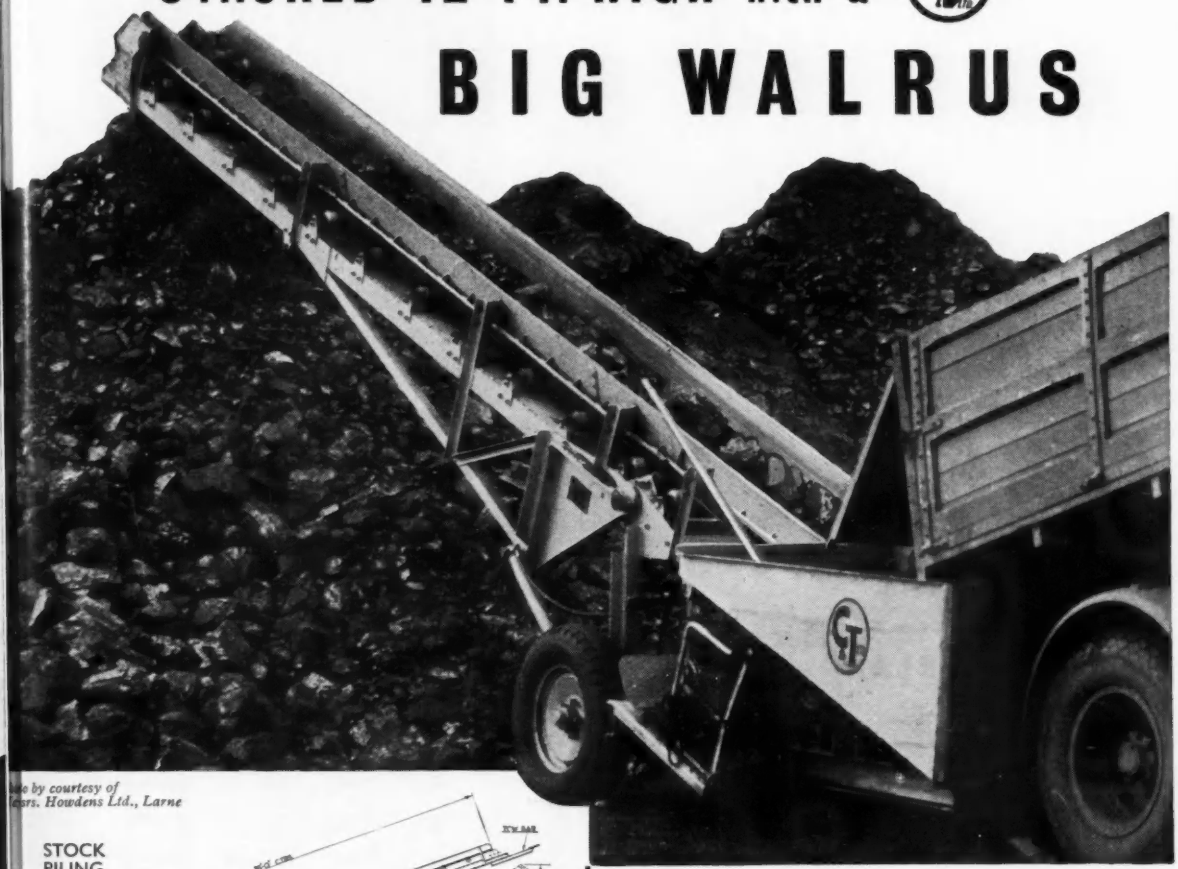
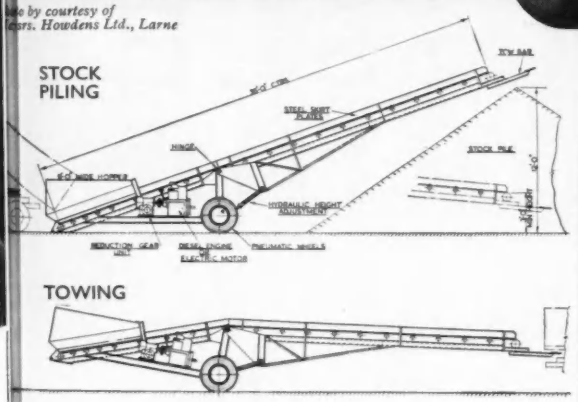


Photo by courtesy of Messrs. Howdens Ltd., Larne



Our range includes; mobile or static conveyors, package stackers, mobile screens, etc.

A brilliant new addition to our famous range of stackers. The "BIG WALRUS" is fully mobile on pneumatic tyres and completely roadworthy having brakes and built in tow bar. The feed hopper is fitted with elevating gear to give a road clearance of 12 ins.

The "BIG WALRUS" gives trouble-free service — stacking to an effective height of 12 ft. Delivery angle can be adjusted from 3 ft. to 13 ft. 3 ins. by either hand or power operated hydraulic gear.

Normal capacity 120 tons coal or 250 tons chrome ore per hour—can be increased if desired.

Powered by Electric or Diesel.

Early delivery. Full details gladly sent.

CRONE & TAYLOR (ENGINEERING) LTD.

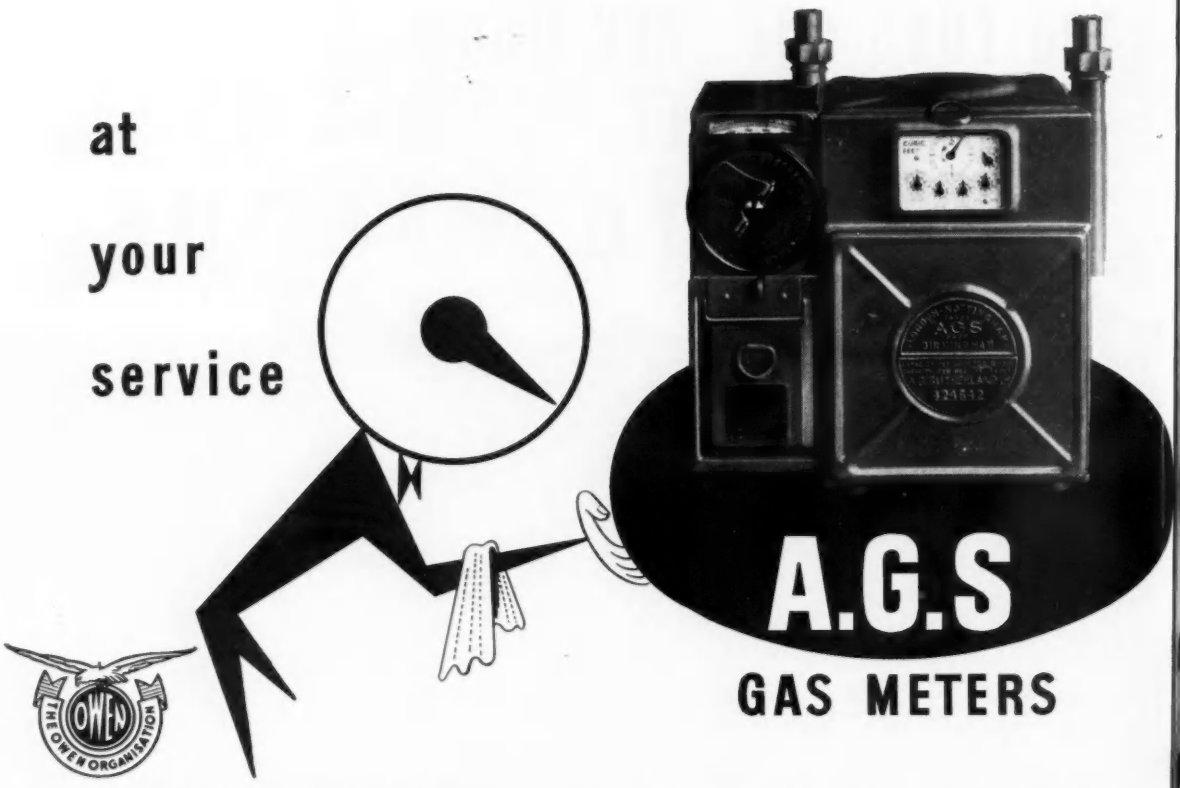
TTON OAK, ST. HELENS, LANCS.
CABLES:

MEMBERS OF THE INTERNATIONAL CARGO HANDLING CO-ORDINATION ASSOCIATION
I.C.H.C.A.

TELEPHONE: ST. HELENS 3283
CRONTAYLOR PHONE, ST. HELENS

ST

at your service



A.G.S
GAS METERS

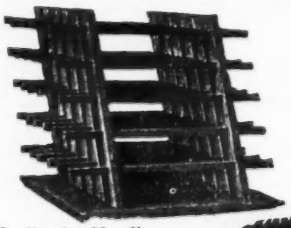
THE OWEN ORGANISATION

A. G. SUTHERLAND LTD. WARWICK ROAD · GREET · BIRMINGHAM,
and at LONDON and NOTTINGHAM.

CROSSLEY GRIDS

for

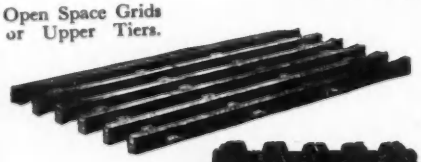
PURIFIERS, SCRUBBERS AND WASHERS



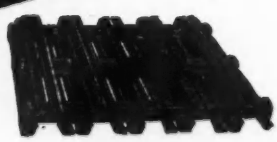
Inclined Hurdles (Light or Heavy Type) with Bottom Flat Grids.

Scrubber Grids.

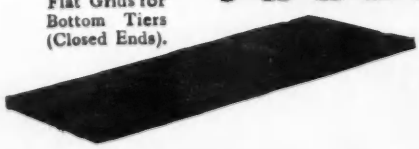
Open Space Grids or Upper Tiers.



Patent Double-Barred Grids.



Flat Grids for Bottom Tiers (Closed Ends).



Embody the latest improvements—are of the very best quality—and are in use extensively throughout the Kingdom

Send your enquiries for any kind of Grids to :—

CROSSLEY BROTHERS,
GRID WORKS, BISPHAM, LANCS.
Telephone : BLACKPOOL 51005 (2 lines). *Telegrams :* "WOODWARE, BISPHAM."

They must see it!

...it's now in CREAM

58 GNS. (TAX PAID)

The latest Electrolux GAS REFRIGERATOR

... sized and priced for the majority of homes

You open the door to increased Electrolux Gas Refrigerator sales in 1956 by opening the door of this handsome CREAM refrigerator. Let your customers admire its turquoise facings . . . its turquoise doorshelves. Also let them see this model in gleaming WHITE. Tell them why this latest Electrolux—built for long, dependable *silent* service—offers so much at a family man's price.

- **Shelf area 5 sq. ft. Adjustable shelves.**
- **A door to store more.**
- **Permanently silent operation by gas.**
- **Cooling unit guaranteed 5 years.**
- **Larger models —5 cu. ft. & 7¼ cu. ft.**

ELECTROLUX — THE FLAME THAT FREEZES

ELECTROLUX LIMITED, 153/5 REGENT STREET, LONDON, W.1

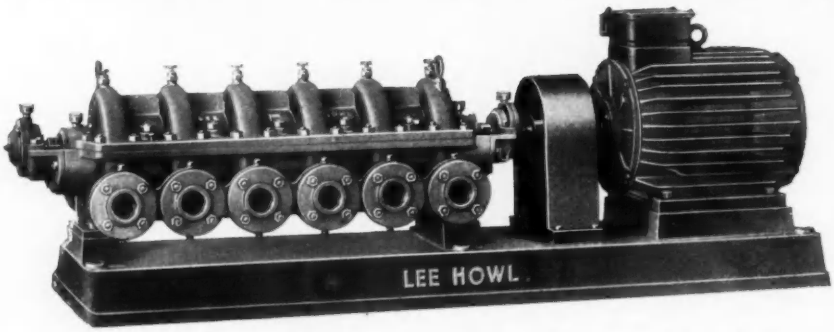
TRADE MARK

MULTICELL CENTRIFUGAL PUMPS

FOR

BY-PRODUCT PLANTS

FOR THE EXTRACTION OF BENZOLE, NAPHTHALENE and AMMONIA



PHOTOGRAPH SHOWS A 2" SIZE SIX CELL PUMP WITH CIRCULAR FLANGES

LEE, HOWL & CO., LTD.

London Office:
375 REGENTS PARK ROAD,
FINCHLEY, LONDON, N.3.

TIPTON, STAFFS.

Glasgow Office:
68 GORDON STREET,
GLASGOW, C.1.

SPECIALISTS
FOR OVER 100
YEARS IN

Leathers

FOR THE
GAS INDUSTRY

STRENGTH
ACCURACY
DURABILITY
DEPENDABILITY

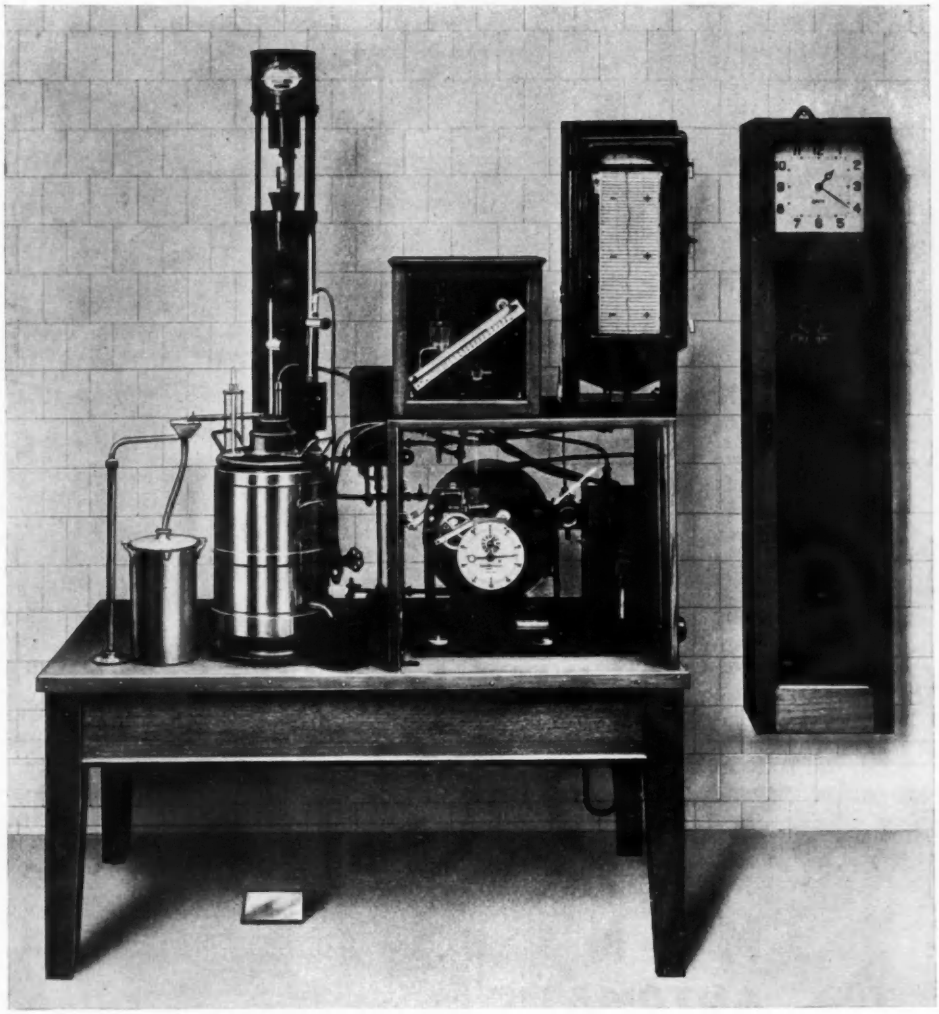
DIAPHRAGM & GENERAL LEATHER CO. LTD.

FRANKLIN ROAD WORKS · PORTSLADE · SUSSEX

Telephone: HOVE 47266/7

Telegrams: DIAPHRAGM, PORTSLADE

THE — NEW DESIGN
— FAIRWEATHER RECORDING CALORIMETER, MARK II



The new Fairweather Recording Calorimeter, Mark II, possesses all the accuracy and efficiency of its larger predecessor, but with many important improvements—

- AUTOMATIC TABULAR COMPENSATOR
- FIXED WATERHEAD COLUMN
- SUBSTANTIAL ECONOMY IN WATER USAGE
- COMPACT IN SIZE: CAN BE HOUSED IN A ROOM WITH CEILING HEIGHT AND FLOOR SPACE OF NORMAL DIMENSIONS
- AN INSTRUMENT IDEALLY SUITED FOR WORKS' CONTROL OPERATIONS
- APPROVED BY THE MINISTRY OF FUEL & POWER FOR OFFICIAL TESTINGS

SCIENTIFIC & PROJECTIONS LTD.

GOVERNMENT BUILDINGS, KIDBROOKE PARK ROAD, KIDBROOKE, LONDON, S.E.3

Telephone: LEE GREEN 2112 (4 lines) *Telegrams:* SCIEPRO, BLACKVIL, LONDON

'IMUNOL' at the 'Home of Steel'

Photograph by courtesy of
Messrs. United Coke & Chemicals Co., Ltd.,
Associated with
United Steel Companies Ltd.,
Gasholders at
Orgreave Coke & Chemicals Plant
protected with Imunol

Write for particulars of
'Imunol' the automatic Gas Holder Paint

London Office: 348, UPPER RICHMOND ROAD, PUTNEY, LONDON, S.W.15.
Tel: PUTney 3376

INERTOL CO. LTD., WEST CARR LANE STONEFERRY · HULL
TELEPHONE: 33701 **TELEGRAMS: INERTOLCO, HULL.**

SIMON
PATENT AUTOMATIC COKE WEIGHER

Approved by the Board of Trade and stamped by the Weights and Measures Authorities.

Capacity: 28 to 112 lbs. per discharge (nett).

Speed of Weighing: Up to six weighings per minute.

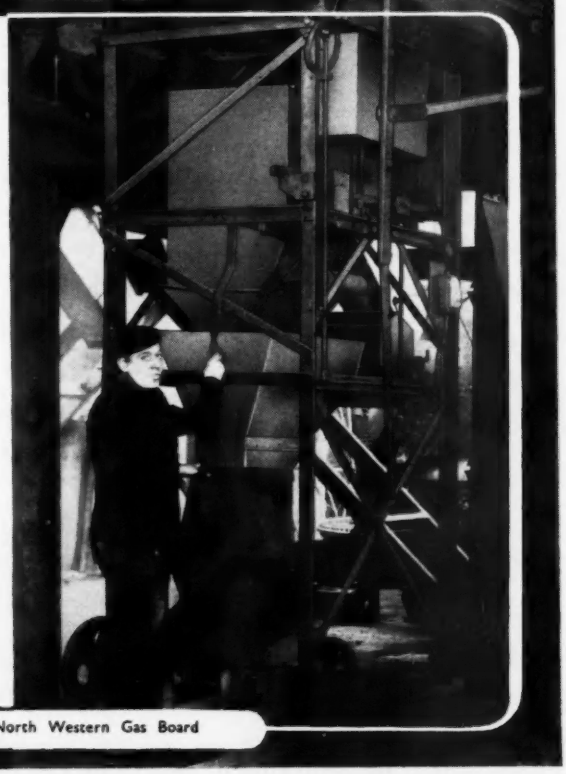
Guaranteed accuracy and continuity of operation.

Machines may be seen working by appointment.

•

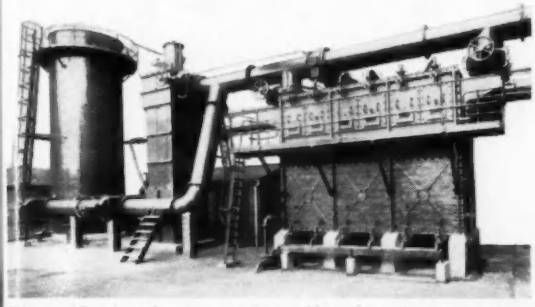
RICHARD SIMON & SONS, LTD.
PHOENIX WORKS, VERNON ROAD
BASFORD, NOTTINGHAM

Telephones: 75136-7-8

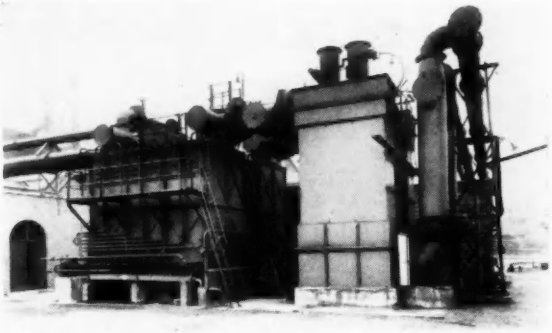


By Courtesy of the North Western Gas Board

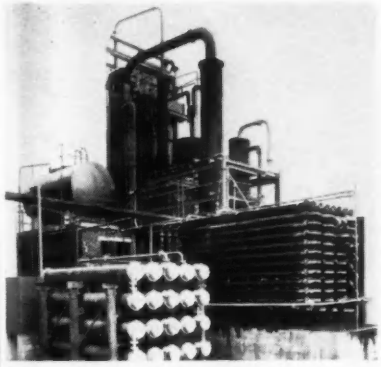
PLANT FOR THE GAS INDUSTRY



Wet purification plant comprising mild steel condenser, cast iron ammonia washer and plate-type electro-detarrer at Norwich for Eastern Gas Board.

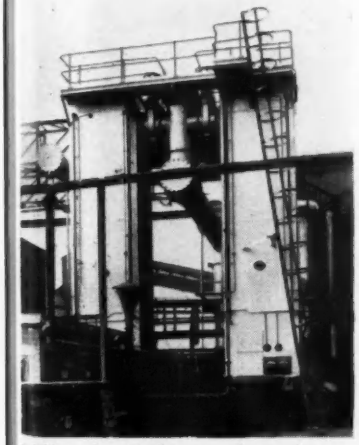


Washers and detarrers at New Wortley for North Eastern Gas Board.

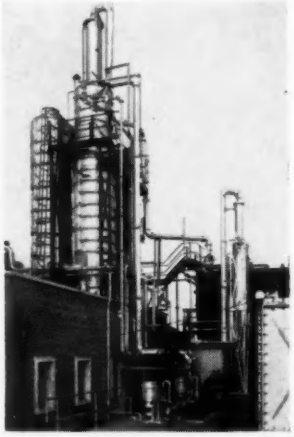


Effluent liquor treatment plant for Southern Gas Board.

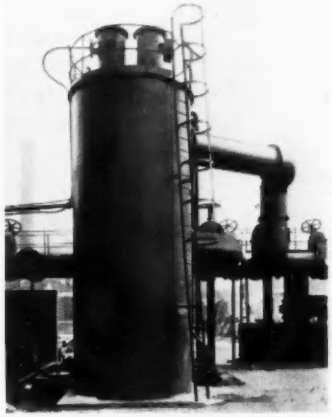
Simon-Carves design and build a complete range of gasworks ancillary plants including condensers, electro-precipitators, ammonia and naphthalene washers, and plants for benzole extraction and rectification, ammonia liquor concentration, liquid purification (H_2S removal) and effluent liquor treatment.



Mild steel vertical water-tube condensers at Bristol (Canon's Marsh Gasworks) for the South Western Gas Board.



Concentrated ammonia liquor plant at Bristol for South Western Gas Board.



Tube-type electro-detarrer at Oldham for North Western Gas Board.

Complete gasworks plant

by ***Simon-Carves Ltd*** SIMON ENGINEERING GROUP

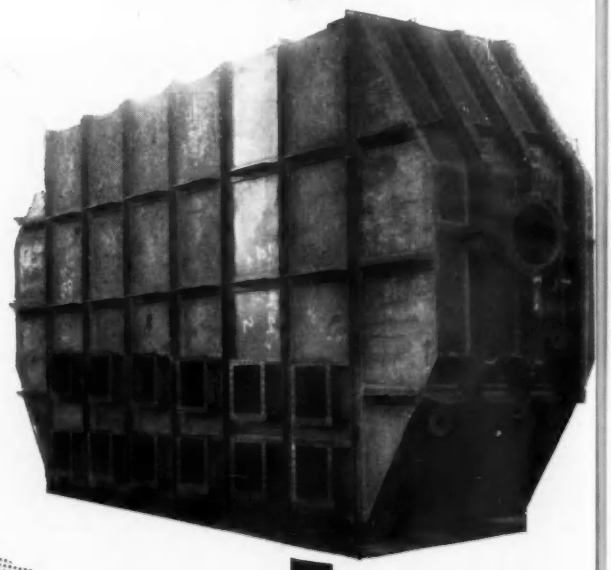
STOCKPORT . ENGLAND

OVERSEAS COMPANIES | *Simon-Carves (Africa) (Pty) Ltd: Johannesburg* *Simon-Carves (Australia) Pty Ltd: Botany, N.S.W.*

C 139

GASWORKS PLANT

One of three all welded mild steel Fraction Storage tanks 9′ 0″ × 23′ 0″ long with internal heating coils being tested at works prior to despatch.



One of four all welded mild steel ammonia scrubber casings 27′ 7″ long × 15′ 0″ deep × 7′ 9″ wide, erected for inspection at works prior to despatch.

EDWARD Cockey & SONS LTD.
GARSTON WORKS
FROME

Your enquiries and Technica
Problems will be welcome

TELEPHONE: FROME 20
TELEGRAMS: COCKEYS FROM

H&G

TOWN GAS FROM HEAVY OIL

Alexandria	1	570,000
Algiers	2	2,500,000
Ajaccio	2	600,000
Barcelona	1	1,250,000
Bedford	**1**	**2,000,000**
Berlin	2	3,780,000
Bilston	**1**	**3,000,000**
Cahors	2	720,000
Carlisle	**1**	**1,000,000**
Constantine	2	830,000
Coventry	**2**	**6,000,000**
Dunstable	**2**	**6,000,000**
Florence	2	3,780,000
Fulham	**2**	**4,000,000**
Hastings (N.Z.)	**1**	**300,000**
Messina	2	1,500,000
Montlucon	2	2,500,000
Nice	1	1,890,000
Northampton	**2**	**6,000,000**
Nortorf	1	100,000
Paramaribo	2	1,290,000
Perpignan	2	2,500,000
Philippeville	1	420,000
Point of Ayr	**1**	**1,500,000**
Portsmouth	**1**	**2,000,000**
Quimper	2	2,500,000
Romford	**2**	**4,000,000**
Sao Paulo	1	100,000
Sheffield	**2**	**10,000,000**
Singapore	**3**	**4,500,000**
Solihull	**1**	**500,000**
Stafford	**1**	**1,000,000**
Surabaja	2	3,000,000
Terni	2	8,900,000
Thetford	**2**	**600,000**
Toulouse	4	11,500,000
Tunis	2	3,630,000
Verona	2	2,270,000

108,000,000 cu.ft

of gas will be produced daily by the 65 Units of Onia-Gegi Plant now in operation or in course of construction.

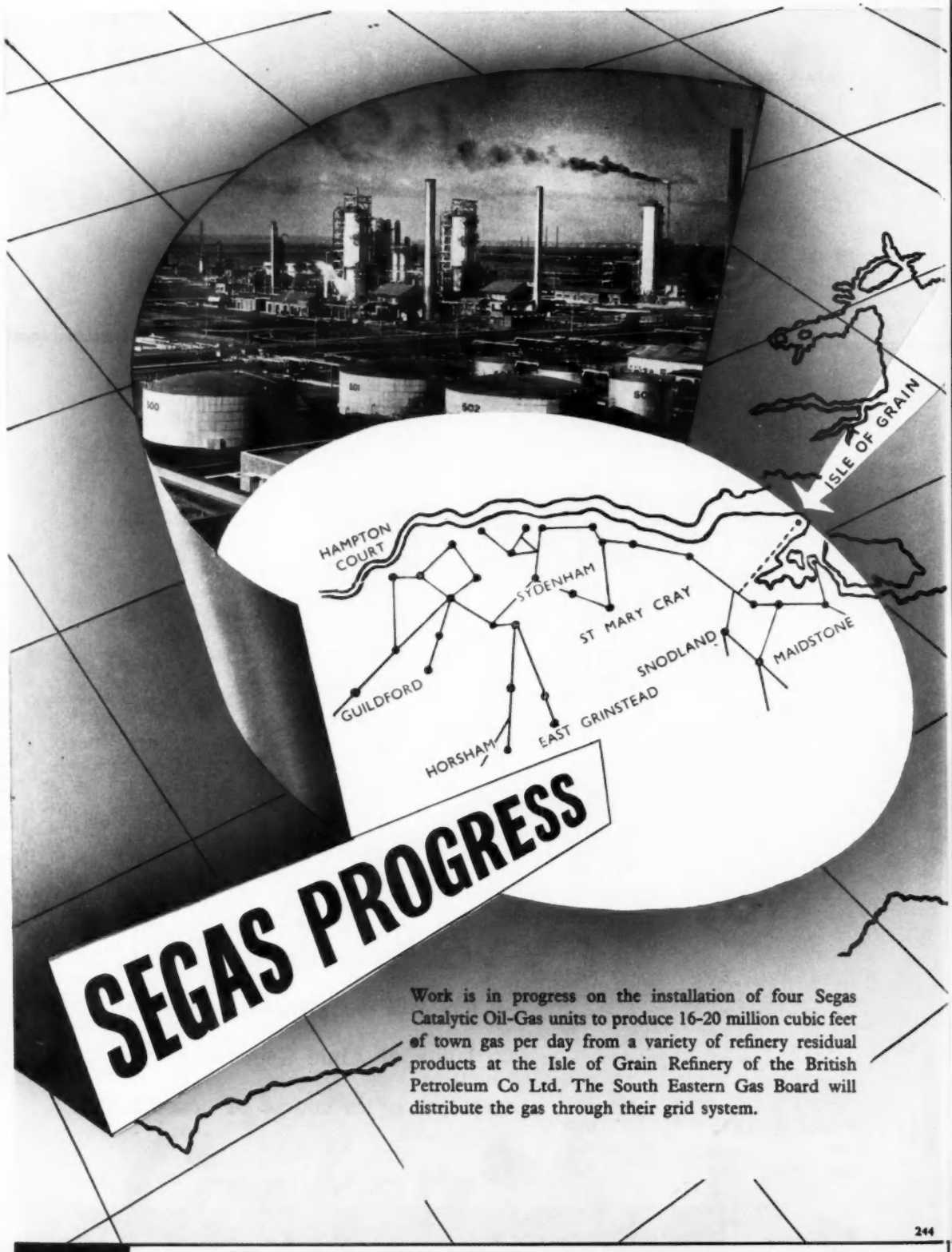
ESTABLISHED 1892

HUMPHREYS & GLASGOW LTD

HUMGLAS HOUSE · CARLISLE PLACE · LONDON S.W.1

Telephone: VICtoria 8454

AUSTRALIAN OFFICE: BERGER HOUSE · 62 ELIZABETH STREET · SYDNEY · N.S.W.



SEGAS PROGRESS

Work is in progress on the installation of four Segas Catalytic Oil-Gas units to produce 16-20 million cubic feet of town gas per day from a variety of refinery residual products at the Isle of Grain Refinery of the British Petroleum Co Ltd. The South Eastern Gas Board will distribute the gas through their grid system.

244

PGC

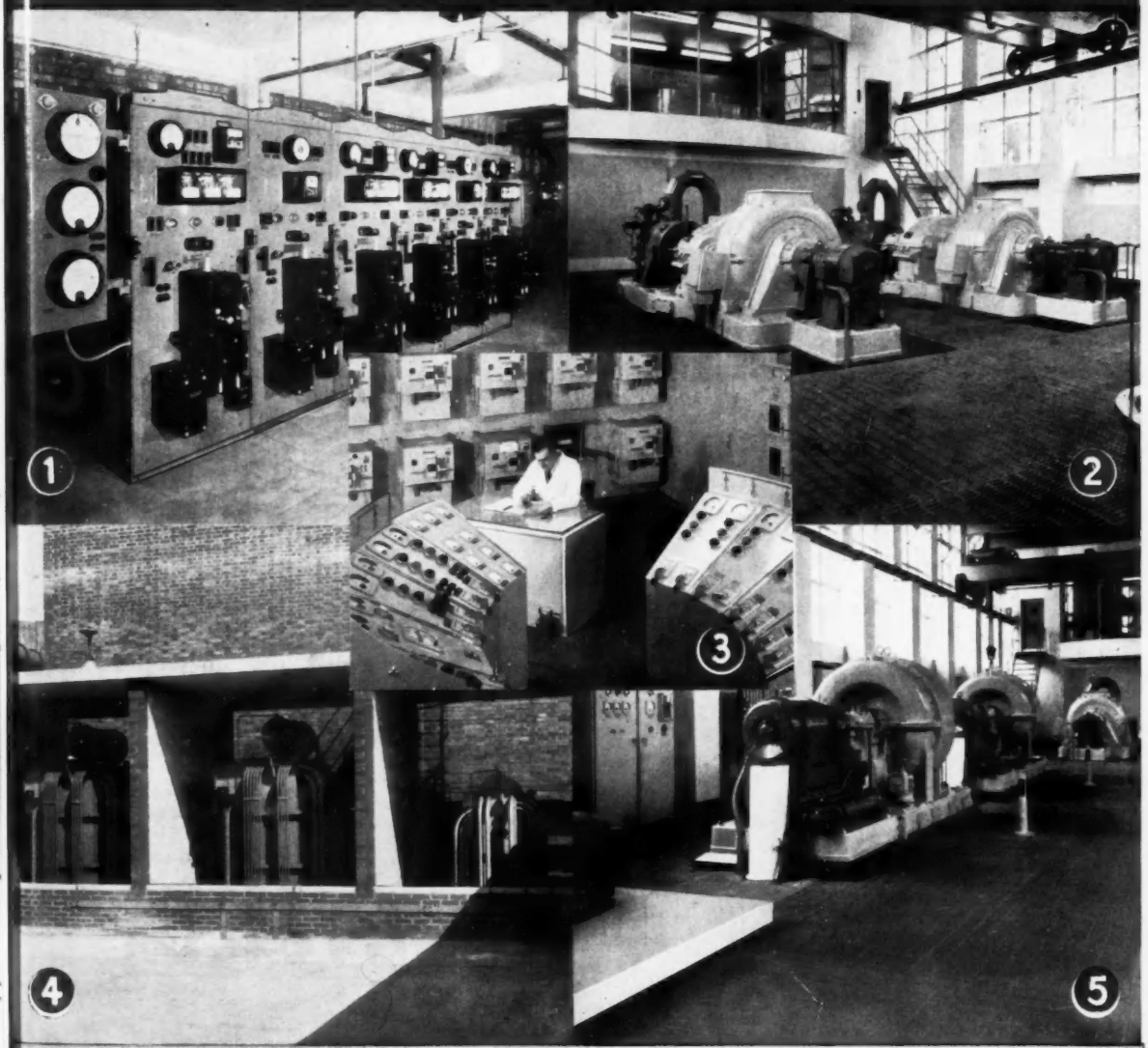
THE POWER-GAS CORPORATION LTD

(PARENT COMPANY OF THE POWER-GAS GROUP)

STOCKTON-ON-TEES AND LONDON

AUSTRALIA · CANADA · INDIA · FRANCE · SOUTH AFRICA

ELECTRICAL EQUIPMENT *serves* SWAN VILLAGE



1 TRUCK TYPE L.T. MAIN SWITCHGEAR, REMOTELY CONTROLLED
2 BACK PRESSURE TURBO-ALTERNATORS, 1750 kVA CAPACITY
3 WITHDRAWABLE TYPE DISTRIBUTION SWITCHGEAR AND CONTROL DESK
4 POWER TRANSFORMERS — 4000 kVA TOTAL CAPACITY
5 EXHAUSTER MOTORS

PHOTOGRAPHS REPRODUCED BY KIND PERMISSION OF WEST MIDLANDS GAS BOARD.
J. E. WAKEFORD ESQ., M.B.E., M.INST.GAS E., M.INST.F., DIVISIONAL GENERAL MANAGER.

ESTABLISHED 1882

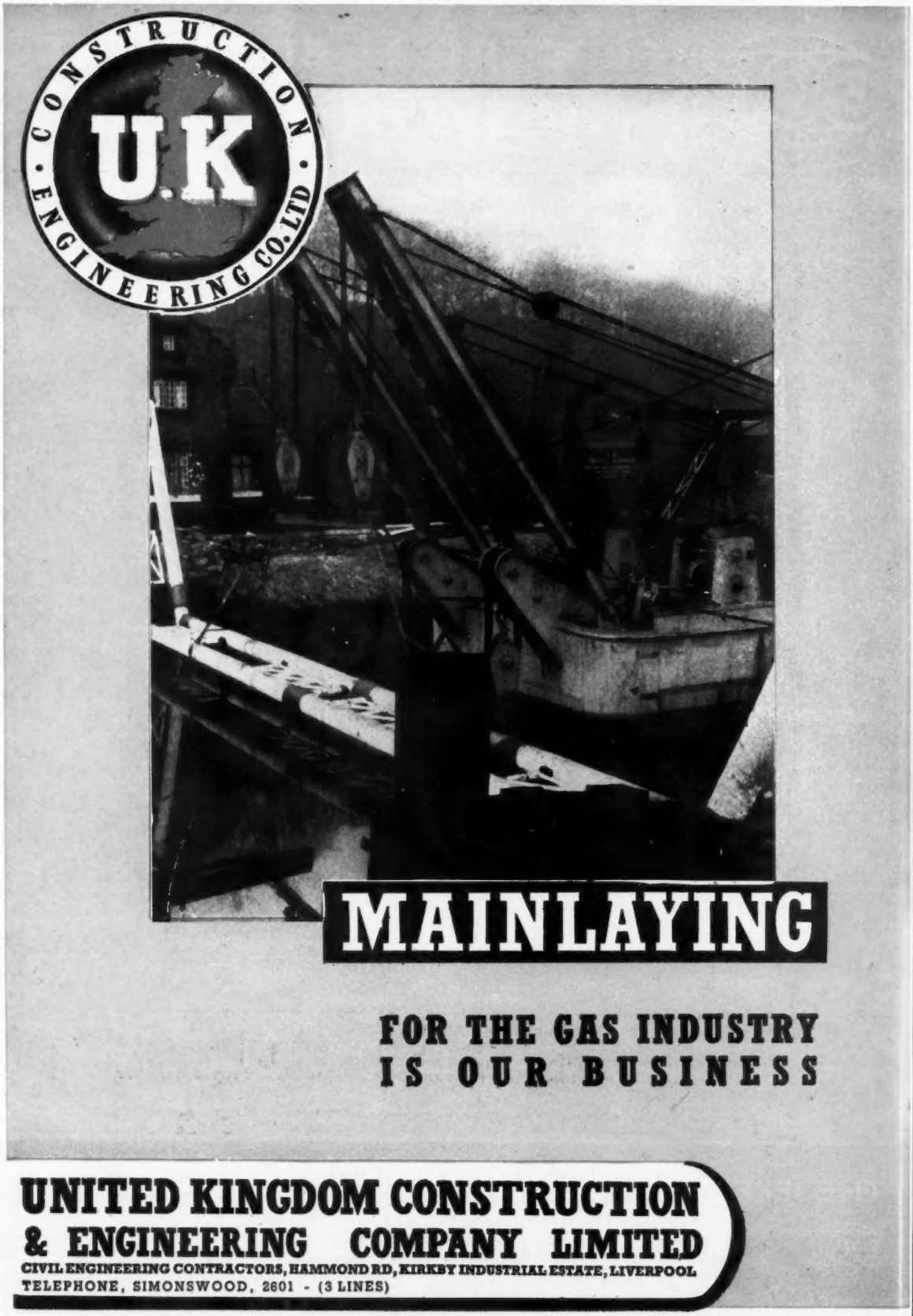
THE ELECTRIC CONSTRUCTION COMPANY LTD.

TELEGRAMS: ELECTRIC WOLVERHAMPTON

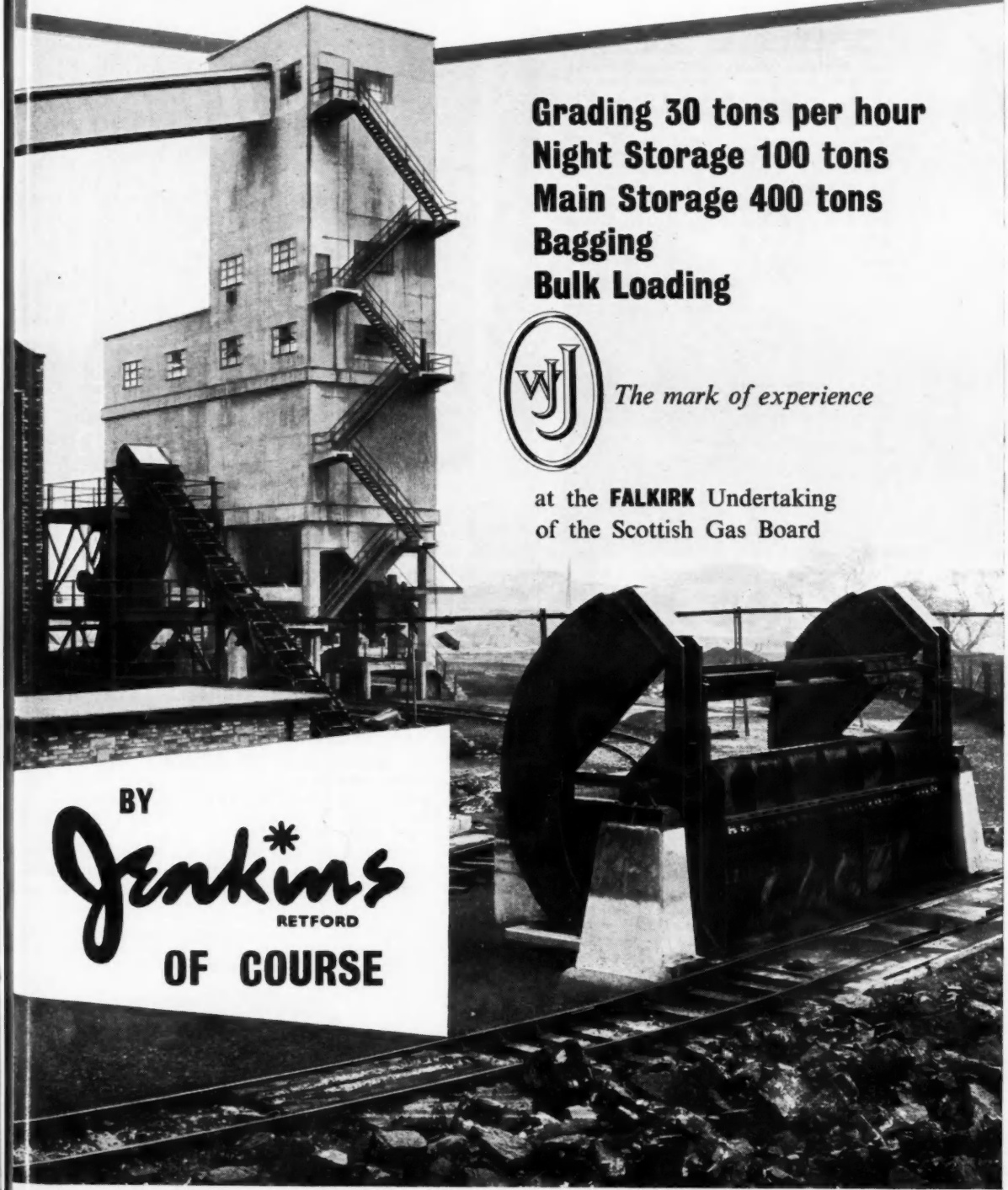
Head Office and Works:
BUSHBURY ENGINEERING WORKS
WOLVERHAMPTON
ENGLAND

TELEPHONE: WOLVERHAMPTON 21455 (7 LINES)

Manufacturers of Rotating Electrical Machinery, Switch and Control Gear, Rectifiers and Transformers.


CONSTRUCTION
U.K
ENGINEERING CO. LTD.
MAINLAYING
FOR THE GAS INDUSTRY
IS OUR BUSINESS
UNITED KINGDOM CONSTRUCTION
& ENGINEERING COMPANY LIMITED
CIVIL ENGINEERING CONTRACTORS, HAMMOND RD, KIRKBY INDUSTRIAL ESTATE, LIVERPOOL
TELEPHONE, SIMONSWOOD, 2601 - (3 LINES)

COAL HANDLING . . . 100 tons per hour
COKE HANDLING . . . 40 tons per hour



Grading 30 tons per hour
Night Storage 100 tons
Main Storage 400 tons
Bagging
Bulk Loading

WJ *The mark of experience*

at the **FALKIRK** Undertaking
of the Scottish Gas Board

BY
Jenkins
RETFORD
OF COURSE

W. J. JENKINS & CO. LTD., RETFORD, NOTTS. (Tel: 2231 6 lines)

E

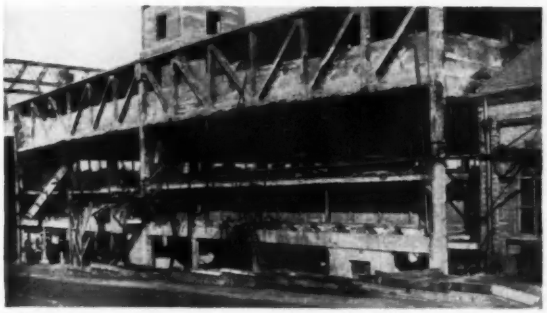
GUNITE *in the service of the Gas Industry*

Reinforced concrete structures such as bunkers, telpher supports, gantries, etc., subjected to attack by the aggressive atmosphere in gasworks, and by dilute sulphuric acid released from wet coal, can be restored to as-new condition by means of the Gunite Process.

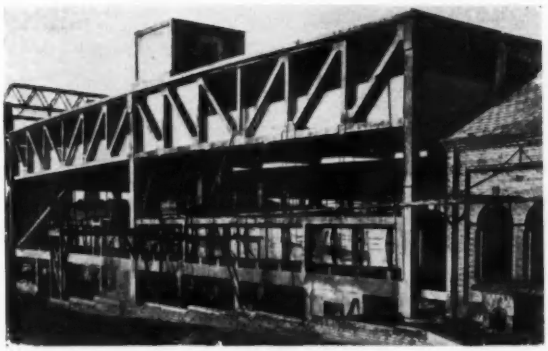
Gasholder tanks which are leaking may often be repaired by lining with reinforced gunite and by pressure grouting the filling behind the wall and under the dumpling.

Steel bunkers can be given a lining of reinforced gunite as a protection against abrasion and corrosion.

Before deciding on costly rebuilding or replacement why not consult us?



Before



After

Reinforced Concrete Gas Purifier Structure, repaired throughout by the Gunite Process, without interference with production, for the North Western Gas Board, Bolton Group.

Our descriptive leaflet "The Gunite Process" is sent free on request

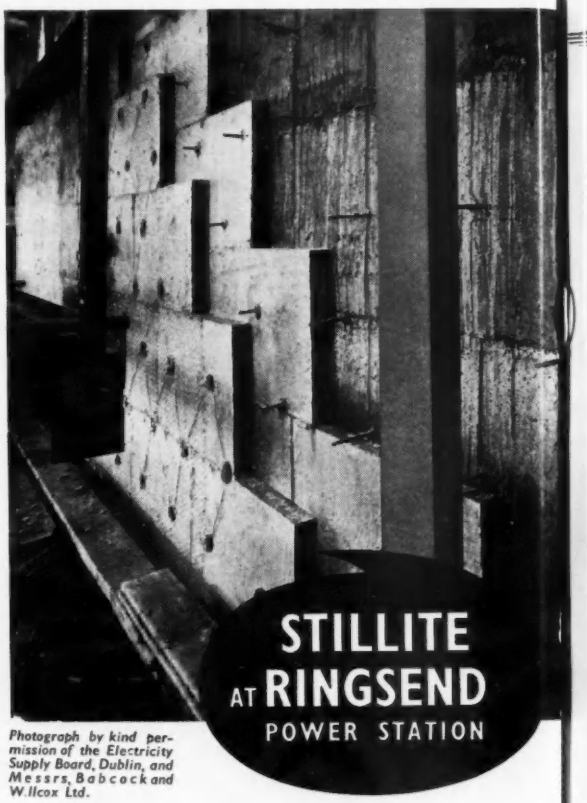
WHITLEY MORAN
AND COMPANY LIMITED

Specialists in the Repair of Engineering Structures

5 OLD HALL STREET, LIVERPOOL, 3

Telephones: CENTRAL 7975/6. *Grams:* GUNITE, LIVERPOOL, 3.

THERBLOC *proves itself*



Photograph by kind permission of the Electricity Supply Board, Dublin, and Messrs. Babcock and Wilcox Ltd.

THERBLOC mineral fibre insulating slab is rapidly replacing conventional backings to refractory materials in a wide variety of industries. The Photograph shows STILLITE THERBLOC applied in two staggered layers to the outer surface of the castable refractory and held by pins secured to the tubes.

THERBLOC is one of the STILLITE range of mineral fibre insulants, and has these advantages :

- ★ **The optimum density of THERBLOC ensures maximum thermal efficiency.**
- ★ **The resilient texture of THERBLOC minimises the resultant of expansion stresses, and enables butt joints to be made imperceptible and heat-tight.**
- ★ **THERBLOC is easily worked, thus eliminating the necessity for special shapes and ensuring a high standard of finish.**
- ★ **THERBLOC affords fire protection and acts as an acoustic leaf.**

The joint sub-contractors for the application of THERBLOC at the Ringsend Power Station were Peter O'Connor (Insulating) Ltd. and M. A. Boylan Ltd., of Dublin.

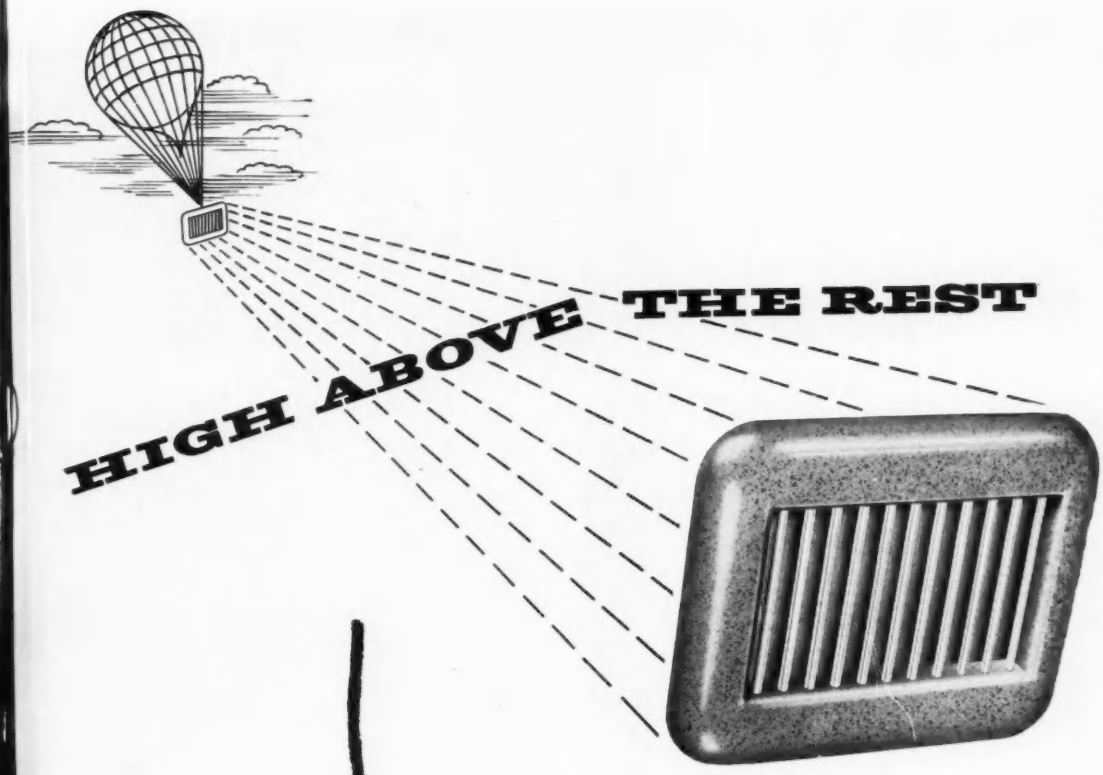
THERBLOC

THERBLOC is one of the STILLITE range of mineral fibre insulating materials for all industrial purposes up to 1500°F.

STILLITE PRODUCTS LTD

15 WHITEHALL, LONDON, S.W.1

Telephone : WHitehall 0922/6 Telegrams : Stillomite, Parl, London



HIGH ABOVE THE REST

THERE'S NO DOUBT ABOUT IT — the "Mastertherm" is a winner! Latest in the RADIANT-HEATING range, astonishing demand has already proved its undoubted success. Fitted with patent, flameless burners, the "Mastertherm" can be tilted to any angle between 30° and 75°. It is thus equally efficient whether installed at high or low levels. Radiant, healthy heat—like heat from the sun—is directed downwards and outwards, ensuring an exceptionally wide area of distribution. This heater is particularly suitable for lofty buildings, such as factories and churches, and is designed for use on low pressure town gas or liquid petroleum gases. Available in two sizes for wall or suspension fitting, the "Mastertherm" is the *cheapest system of heating you can install.*

Remember — the "Mastertherm" is made by RADIANT-HEATING, makers of the "Floortherm", "Supertherm" and "Golden Glow" . . . and a host of other superior gas appliances. For this reason alone, you can recommend the "Mastertherm". It is the finest overhead space heater in the world.

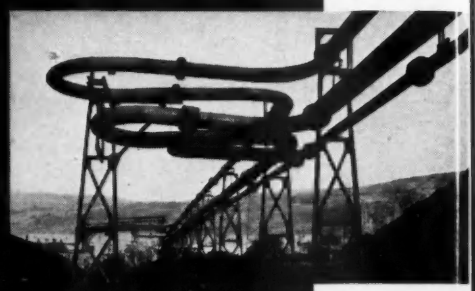
Send for detailed dimension drawings and full particulars of the "Mastertherm"

We've a name for efficient Gas Heating

it's **RADIANT-HEATING LTD**

RADIANT WORKS · BARNSBURY PARK · LONDON · N.1 *Tel: NORTH 1677 (3 lines)*

THE UNIT SUPERHEATER AND PIPE COMPANY LTD



FABRICATORS OF:– Pipework for high or low pressures suitable for steam, water, gas etc.

Water wall headers, Steam and oil receivers, De-Superheater bodies.

Tubular products of all descriptions for power stations and industrial steam raising plants.

As pioneers in Superheat application we build into our Unit Superheaters the accumulative experience gained over 40 years of close specialization.

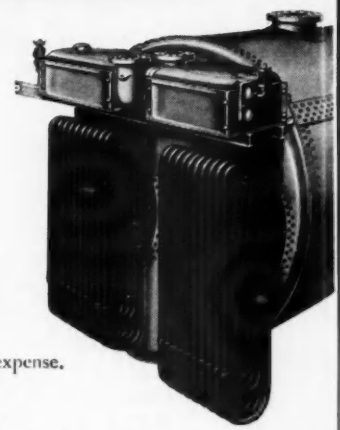
The basic advantages of this application are many and well-known, and the resultant fuel economy well established.

Automatic temperature control of steam within plus or minus 2/5°F. can be readily obtained, adjustable for winter and summer conditions as required.

These advantages are possible by utilizing, re-circulating and flashing to steam, existing condensate water. The Unit system accomplishes more with less expense.

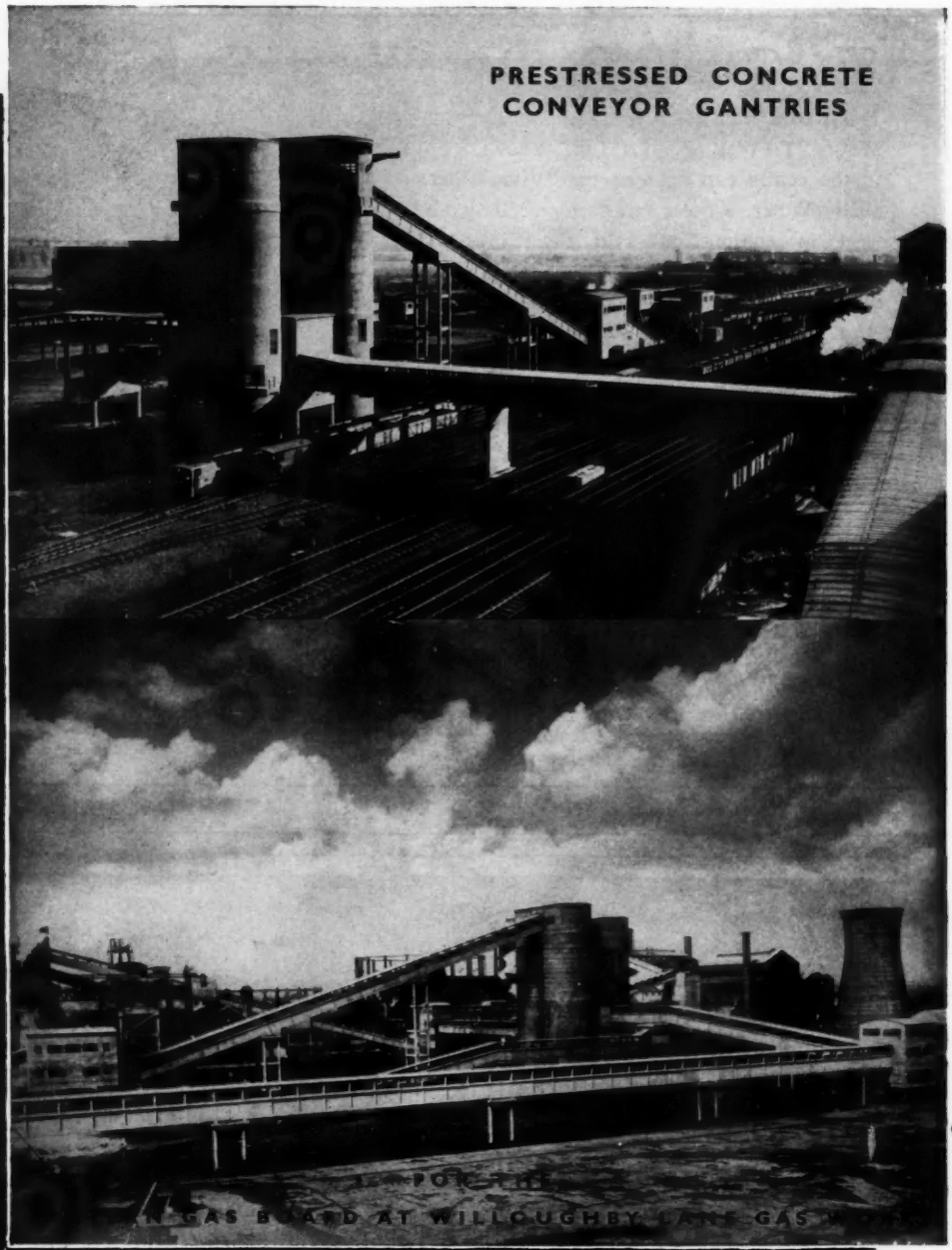
Radiographic services available for inspection and tests.

Expert operators accustomed to welding alloy and other steels for modern high pressure and high temperature steam conditions.



UNIT WORKS, SWANSEA *Telephone: Swansea 4091 (6 lines) Telegrams: 'Superunits', Swansea*

LININGS · SPLASHBACKS · TRAYS · LININGS · SPLASHBACKS · TRAYS · LININGS · SPLASHBACKS · TRAYS ·



PETER LIND & CO LTD

ROMNEY HOUSE, TUFTON STREET, LONDON, S.W.1

TELEPHONE ABBEY 7361

97% Cut in Cooling Water Costs!

This photo was taken in the cold store of Messrs. T. Wall & Sons Ltd., Yeovil. In the centre can be seen the "Visco" Steel Shell Water Cooler (capacity 250 g.p.h.) used in conjunction with the "Prestcold" refrigerating plant. With the "Visco" Cooler, the water is re-circulated continuously without waste. Practically speaking, the user is independent of public supply for cooling water—an important consideration, especially in times of drought. In many cases, water consumption can be reduced by as much as 97%.

Photograph by courtesy of Messrs. T. Wall & Sons Ltd

VISCO STEELSHELL *Water Coolers*

Sizes from 250 g.p.h. upwards.
Write for List No. 514.

We also supply and erect timber-frame and ferro-concrete cooling towers, natural or forced draught, of any capacity required.

Phone: CROydon 4191

VISCO ENGINEERING CO. LTD. STAFFORD RD. CROYDON

ESCOL

THE SYMBOL OF SERVICE AND QUALITY

VITREOUS ENAMELS
VITREOUS ENAMELLING
REFRACTORY COATINGS
ON METAL

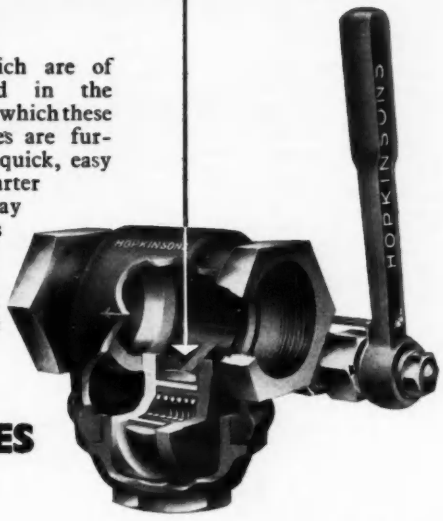
STEWART & GRAY LTD.
PAISLEY WORKS · SWAINS ROAD · TOOTING JUNCTION · S.W.17.

Telephone: MITCHAM 1634 (5 LINES)

Telegrams: ESCOL · TOOT · LONDON

The secret is in the seating . . .

and valve parts, which are of 'Platnam' alloy, and in the parallel-slide action with which these Hopkinsons' Link Valves are furnished. Fluid-tightness; quick, easy operation by less than a quarter turn of the handle; full-way passage and other features make the valve capable of a very wide range of duties - for steam, water, air, oil, or thick heavy fluids. Write for Catalogue 951 - 'Bronze Valves'

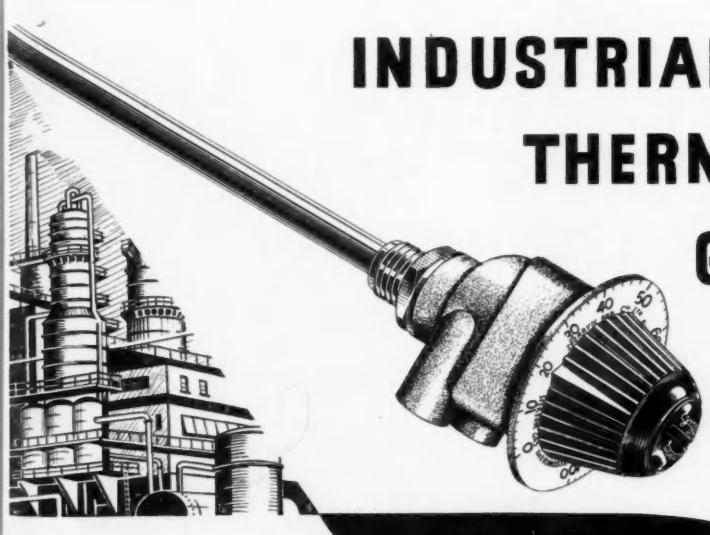


HOPKINSONS' BRONZE VALVES

HOPKINSONS LIMITED · HUDDERSFIELD

LONDON OFFICE: 34 NORFOLK STREET · STRAND · W.C.2.

HV 66



INDUSTRIAL THERMOSTATIC GAS CONTROLS

All Thermostats in this new Industrial Range are dismountable, permitting the cleaning of the interior without any variation in temperature setting.

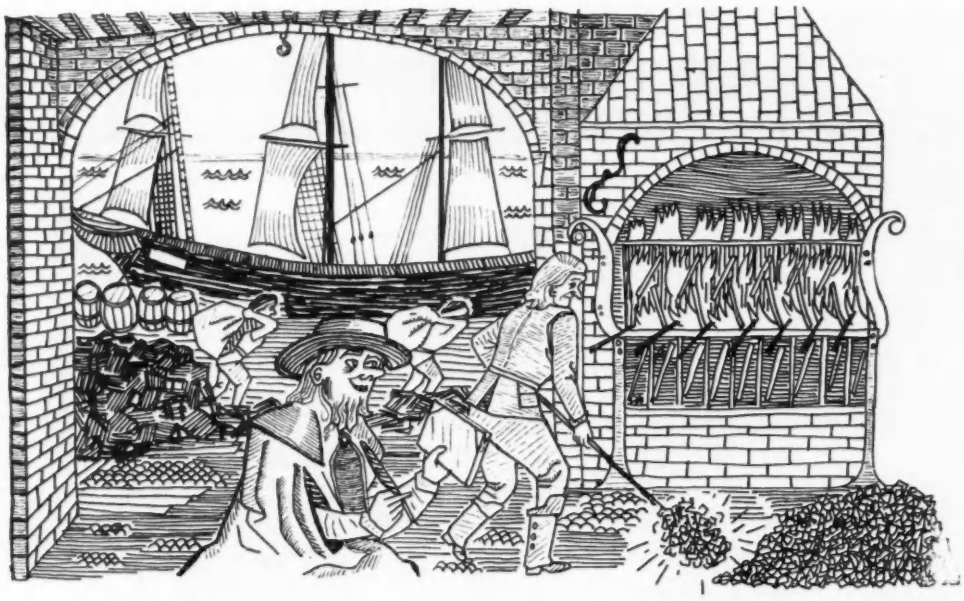
Thermostats in this range include direct and indirect acting types for low, medium and high temperatures. Special models for bakers' ovens and fish frying ranges are also available. For complete details ask for Pamphlet No. R.G.7.

Sperson TRADE MARK

SPERRYN & CO., LIMITED

MOORSOM STREET, BIRMINGHAM, 6. *Telephone: ASTon Cross 4011 (5 lines)*

London Address: 23 GREAT SUFFOLK STREET, LONDON, S.E.1. *Telephone: WATerloo 6418*



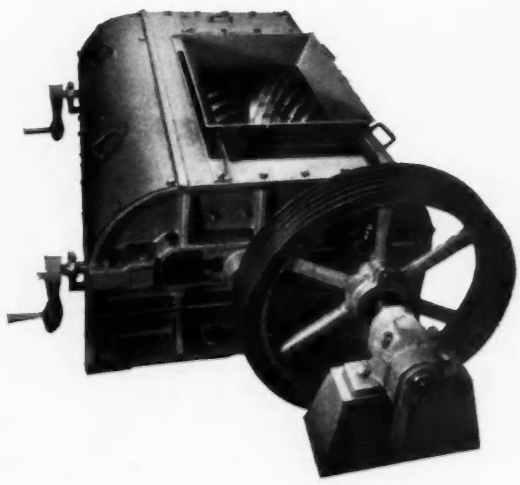
This Changing World

Charring sea coale at Greenwich

On July 11th, 1656, John Evelyn wrote in his now famous diary, "Came home by Greenwich Ferry where I saw Sir John Winter's new project of charring sea coale, to burne without the sulphur and render it sweete". But the first record of the coking of coal was in 1590 when John Thornborough, Dean of York, was granted a patent to "purify pit coal and free it from its offensive smell".

Thus, the gas companies found a ready market for coke, and its manufacture and sale has been an important factor in the economics of gas production. A fact always recognised at the Phoenix Iron Works in Stroud, Gloucestershire where, as early as 1855, specialised plant and equipment was being produced for the gas industry.

A modern Coke Breaker by Waller. Its outstanding features are massive construction, easy adjustment for varying coke grades, rapid cutter replacement, and simplicity of designs.



GEORGE
WALLER
& SON LTD.

Phoenix Iron Works, Stroud, Glos.
Telephone : Brimscombe 2301/2

Member of the Society of British Gas Industries

29967/3

For accuracy in measurement

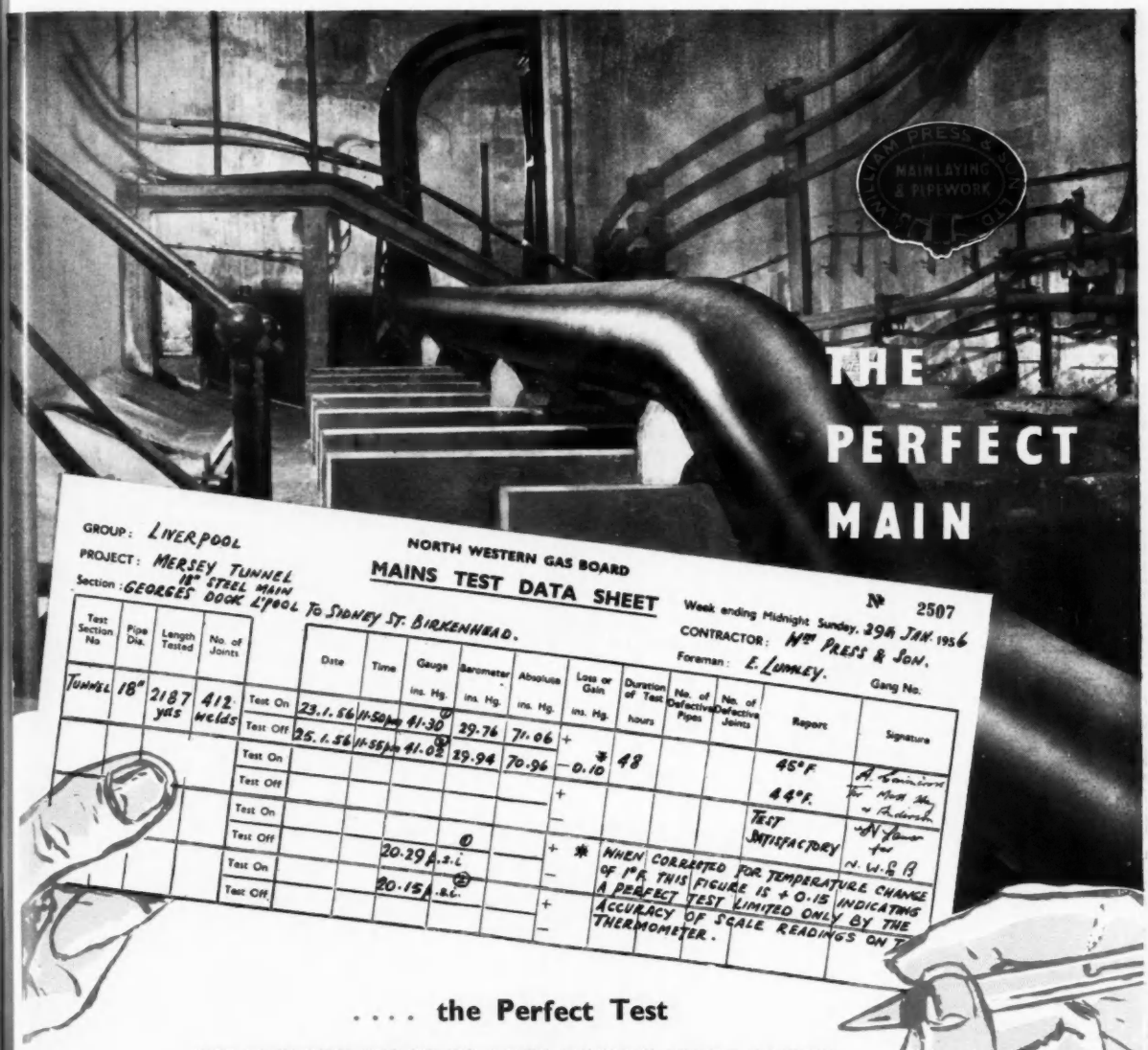
TG 27

the **T.G.** prepayment **D.1 METER**

THOMAS GLOVER & CO. LTD.

GOTHIC WORKS, ANGEL ROAD, EDMONTON, LONDON, and BRANCHES

At all these branches
George Wilson Gas Meters Ltd
produce Meters
to meet your
every need
Glasgow
Jarrow
Manchester
Wolverhampton
Coventry
Cardiff
London


WILLIAM PRESS & SON LTD
MAINLAYING & PIPEWORK
THE PERFECT MAIN
GROUP: LIVERPOOL
PROJECT: MERSEY TUNNEL 18" STEEL MAIN
Section: GEORGES DOCK L'POOL TO SIDNEY ST. BIRKENHEAD.
NORTH WESTERN GAS BOARD
MAINS TEST DATA SHEET
№ 2507
Week ending Midnight Sunday, 29th JAN. 1956
CONTRACTOR: Wm PRESS & SON.
Foreman: E. LUMLEY.
Test Section No | Pipe Dia. | Length Tested | No. of Joints | Date | Time | Gauge ins. Hg. | Barometer ins. Hg. | Absolute ins. Hg. | Loss or Gain ins. Hg. | Duration of Test hours | No. of Defective Pipes | No. of Defective Joints | Report | Signature | Gang No.
TUNNEL 18" 2187 yds 412 welds
Test On 23.1.56 11-50 am 41·30 29·76 71·06
Test Off 25.1.56 11-55 am 41·02 29·94 70·96 − 0·10 48
45°F.
44°F.
TEST SATISFACTORY
WHEN CORRECTED FOR TEMPERATURE CHANGE OF 1°F. THIS FIGURE IS + 0·15 INDICATING A PERFECT TEST LIMITED ONLY BY THE ACCURACY OF SCALE READINGS ON T... THERMOMETER.

.... the Perfect Test

YET ANOTHER PROOF OF HIGH QUALITY WORK BACKED BY 43 YEARS' EXPERIENCE

As many millions of people use the Mersey Tunnel yearly, the installation of the 18" Gas Main called for workmanship and organisation of the highest order. Every welded joint was subjected to radiographic inspection to ensure that the ⅜" thick Steel Main was equal in strength throughout its total length of 6,600 ft. In addition, we were responsible for laying the 4,000 yds. of 18" Cast Iron Approach Mains in the densely built-up areas of Liverpool and Birkenhead, which is just another example of our organisation's versatility.

CAST IRON AND STEEL MAINLAYING — ALL TYPES OF INDUSTRIAL PIPEWORK INSTALLATION — PIPE FABRICATORS TO LLOYDS SPECIFICATION.

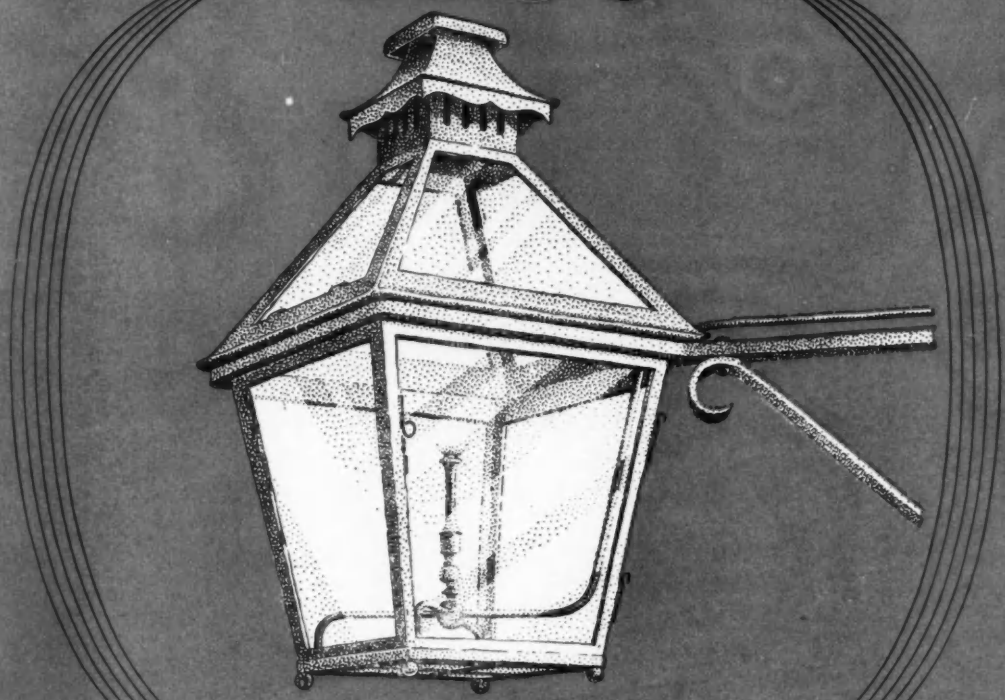
William Press and Son Ltd.

22, Queen Anne's Gate, Westminster, S.W.1.
Telephone: WHitehall 5731 (7 lines)
Telegrams: Unwater Parl, London.

Willoughby Lane, Tottenham, N.17.
Telephone: TOTtenham 3050 (12 lines)
Telegrams: Unwater, Southtot, London.

THE PROGRESS OF GAS

1855



IN 1804, a Mr. Windsor took the Lyceum Theatre, to put on a display of the new marvel, gas-lighting. Three years later, he erected street lighting in Pall Mall, and was floating the National Light and Heat Company.

The crude street burners gave 16 or 18 times as much light as oil lamps, and within ten years much of London's West End was gaslit. The last stronghold of oil — Grosvenor Square — switched to gas in 1846.

The gas lamp shown here is of a type that came in during the 'Fifties' and survived with little change for many years. It had an iron burner that corroded easily, until Sugg, in 1858, devised a burner of non-corrodible steatite. Bunsen's burner, invented in 1855, was designed for heating, but before long was adapted for use with the familiar incandescent gas mantle.

Issued by Imperial Chemical Industries Limited for the interest of the gas Industry — an important user of

I.C.I. copper tubes, capillary and compression fittings

Including: 'KUTERLON' underground copper tubes

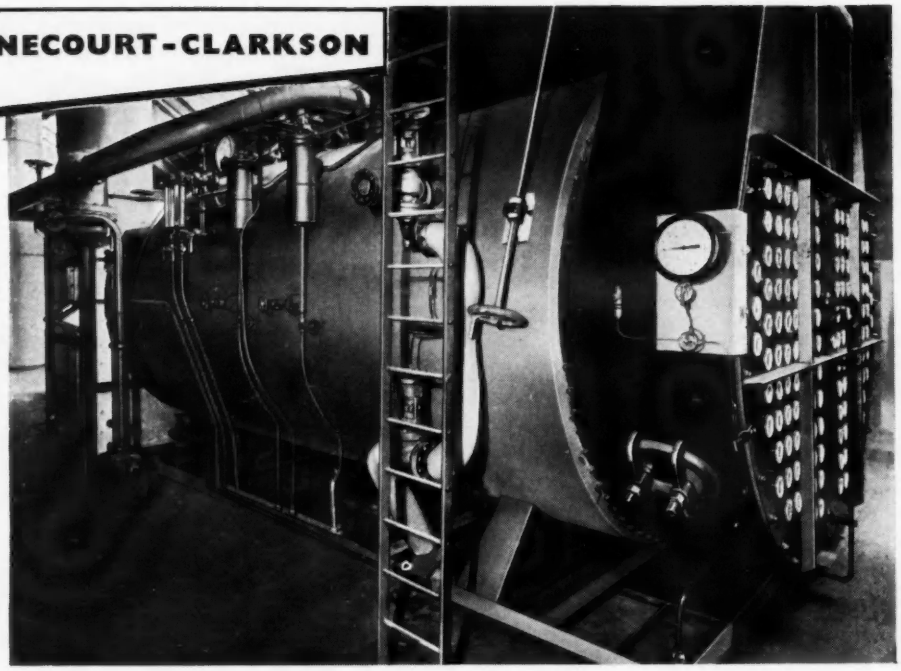
'INTEX P.T.' capillary fittings, 'CONEOR' and 'INSTANTOR' compression fittings

IMPERIAL CHEMICAL INDUSTRIES LIMITED, LONDON, S.W.1

M.394

SPENCER-BONECOURT-CLARKSON
LIMITED

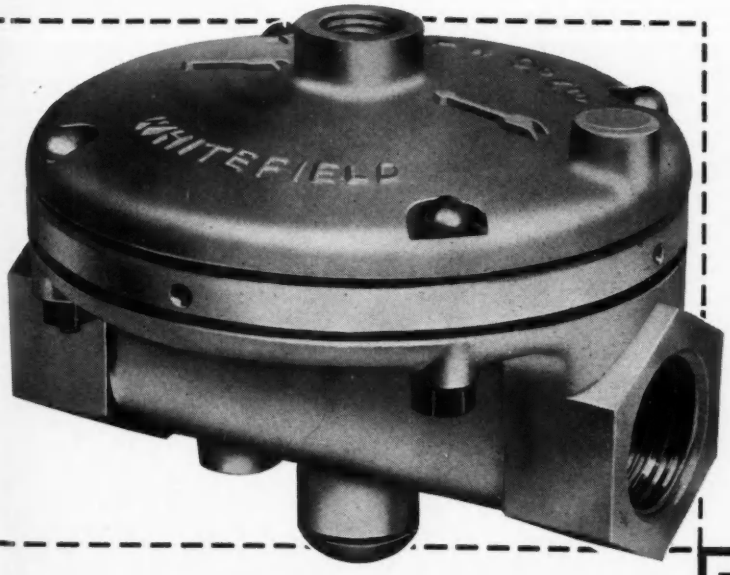
SPECIALISTS IN WASTE HEAT RECOVERY PLANT



The illustration shows one of the Spencer-Bonecourt waste-heat boilers at Stoke-on-Trent Gas Works. Similar units are installed on all the Glover-West Continuous Vertical carbonising plant in this works.

14-15 FETTER LANE, LONDON, E.C.4.

Telephone : FLEet Street 0481 and 6181
Telegrams : HEATECON, PHONE, LONDON



- ★ Aluminium Body (4¼" long) with Aluminium Cover (4" diam.)
- ★ Plastic Diaphragms with air spacer to ensure that Gas and Steam Circuits cannot mix
- ★ Two position bye-pass, if required
- ★ For use on all types of gas fired steaming ovens working at pressures up to 10" w.g.
- ★ Extremely reliable and economical

THORP EQUIPMENT FOR THE GAS INDUSTRY

PRESSURESTAT
FOR USE ON STEAMING EQUIPMENT

THOMAS THORP & CO LTD
WHITEFIELD Manchester

- ★ Gas connections ¾" and 1" B.S.P. female (can be bushed for ½" if required)
- ★ Adjustment for alternative pressures

1210

CONVEYED with SPEED and EFFICIENCY

"COMPASS" BELTING

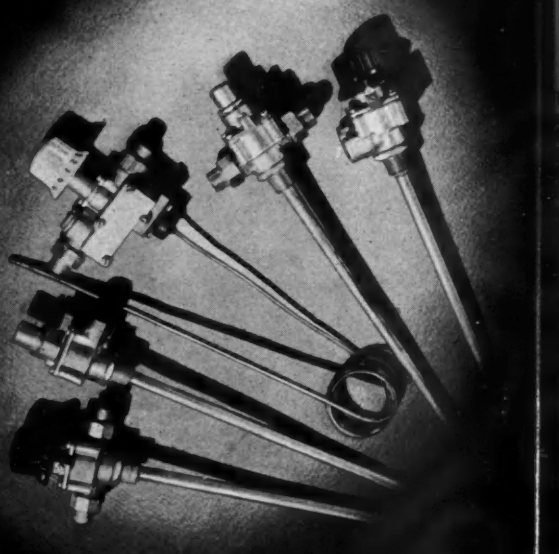
If it's a question of continuously moving materials from one place to another, MacLellan "Compass" Conveyor Belting is the answer. Tough and reliable, MacLellan Beltings are of the highest quality, B.S.I. Specifications being adopted as the *minimum* standard of efficiency. Proof against damp, heat and live steam.

Full details and informative booklet from :—

GEORGE MACLELLAN
AND COMPANY LIMITED
THE GLASGOW RUBBER WORKS · GLASGOW, N.W
Telephone : MARyhill 2255-8
London Warehouse :
BURSTON ROAD · PUTNEY S.W.15

Spotlight on EVERSTATS

These thermostats are examples from the comprehensive range of gas controls now being supplied to the leading manufacturers of domestic and industrial appliances.

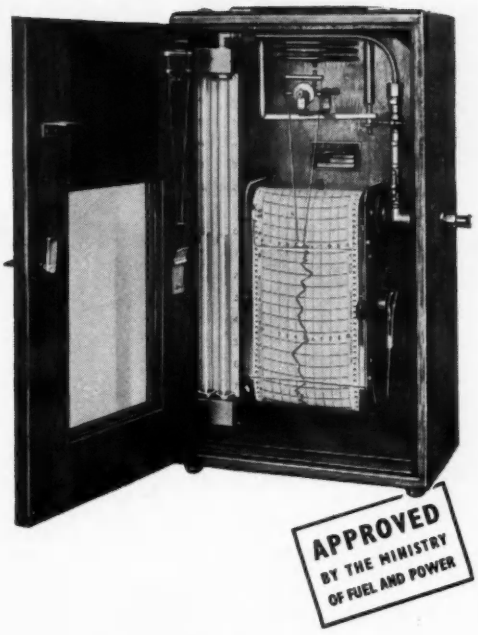


EVERED & COMPANY LIMITED, SURREY WORKS, SMETHWICK 40, STAFFS.
LONDON OFFICE: 23 ALBEMARLE STREET, W.I. SCOTTISH OFFICE: 341 CENTRAL CHAMBERS, 93 HOPE STREET, GLASGOW, C.2.

A NEW low pressure recorder by SIGMA

THE MARK V PRECISION PRESSURE AND VACUUM RECORDER

The Sigma Instrument Company proudly announce the introduction of a new model, containing the many desirable features of the previous Instrument, with the experience gained in accumulated modifications over the past thirty years. A re-designed chart table, incorporating a sprocket drive for the chart, is fitted. The clock being wound with the unique ratchet type key attached to the table. The complete unit, including manometer, is housed in a neatly styled mahogany cabinet. Improved production methods enable us to offer this Instrument at a much lower price than its predecessor. This Instrument has been specially designed and finished for showroom standards.



For further details, write to :—

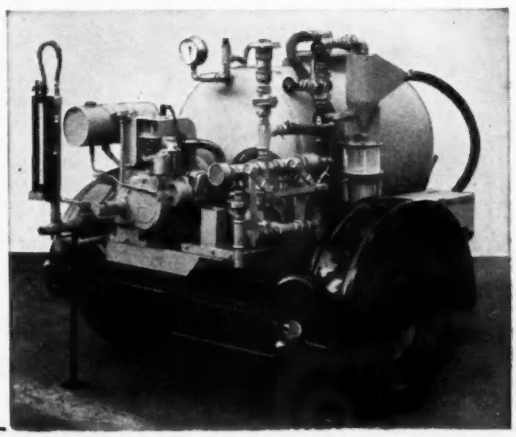
SIGMA
INSTRUMENT CO. LTD

SPRING RD., LETCHWORTH, HERTS.
Telephone: Letchworth 1845 (3 lines)
Telegrams: SIGMA, LETCHWORTH

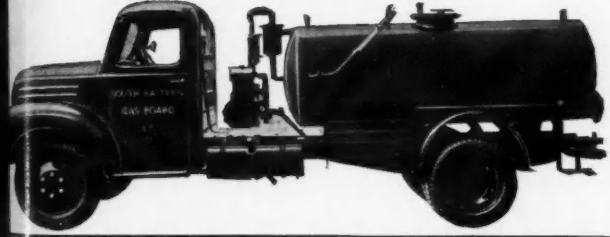
LEANING BLOCKED SERVICE PIPES METHODS REVOLUTIONISED BY

ALLAN TAYLOR SERVICE PIPE CLEANING OUTFIT

e 75 gallon Allan Taylor pressure/vacuum service cleaning equipment mplete with exhauster which can be used for vacuum or pressure. rmally used as a trailer unit and towed by a 10 cwt. van. Visible in photograph (*right*) are the cyclone and test bar. This additional equip- nt enables the operator to make pressure tests before and after cleaning service pipe, the test taps passing 50 cu. ft. or 100 cu. ft. as required. By g the Cyclone the dust drawn from the service pipe is deposited in the t glass for inspection and can then pass into the easily removable con- er below. The arrangement further enables the operator at the machine determine whether or not there has been any success with a cleaning ration. The extractor also prevents the greater part of the rust dust m entering the 75 gallon cylinder.



SYPHON EMPTYING OUTFIT



The Vacuum Syphon Emptying Outfit illustrated is mounted on a 4 ton **Thames** Chassis. A 600 gallon galvanised tank is fitted. A rotary type exhauster is driven by a 4 b.h.p. four-stroke air cooled engine, mounted on a sub-frame behind the cab. The tank is fitted with a flame-proof vent and the outfit can be used for high or low pressure syphon emptying. A large manhole at the rear allows the tank to be cleaned easily. A sight glass is fitted to enable the operator to know when the Syphon is emptied. Twenty-five feet of 1½ in. suction hose is supplied with the outfit. The outfit can be used for vacuum or pressure working.

ALLAN TAYLOR (ENGINEERS) LTD.
ANDSWORTH HIGH STREET, LONDON, S.W.18
Telephone: VANdyke 7222 (ten lines)

ALLAN TAYLOR

THE
SONISCOPE

An entirely new sub-miniature electronic acoustic instrument that can be tuned in to sounds and vibrations far beyond the range of the human ear.

This instrument is very simple to operate, having only three controls. It is possible literally to "tune in" to the frequency required and "tune out" or subdue unwanted frequencies. The Soniscope is completely portable, and independent of outside sources of supply. It is compact measuring only 4¾"x3¼"x1⅝", and weighs only 18 ozs. In addition the Soniscope will drive most types of meters, recorders and graphers, and can also be used with headphones and loudspeaker units.

For fuller information write :—

AIRSONIC LTD.
14 OLD QUEEN STREET, LONDON, S.W.1
(Suppliers of Optical and Acoustical aids to Industry)
TRAfalgar 2255 **Telegrams : Airsonic, Parl, London**

KLEENOFF

The COOKER CLEANER

The Quality pro lu
for Quantity sale
Consistently a
widely advertised.

Sell a Kleenoff Brush
Mop with every tin.

Kay-Dee

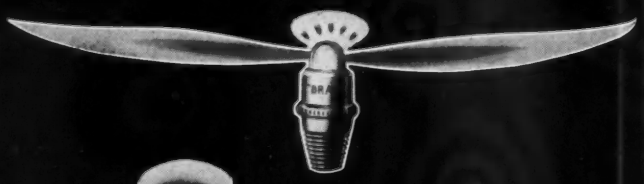
The KETTLE DE-SCALER

Persuasive National Advertising is stepping up the sales — are you making the most of this extra business opportunity by prominently displaying Kay-Dee ?

THE KLEENOFF CO., CROMPTON WAY, CRAWLEY, SUSS

BRAY
NEAT GAS JETS

NON-ATMOSPHERIC AND
ATMOSPHERIC TYPES



for COAL GAS
ACETYLENE
BUTANE · PROPANE
NATURAL GAS
METHANE Etc.

GEO. BRAY AND CO., LTD. LEICESTER PLACE, LEEDS 2
Tel. Leeds 20981/9 Grams. "Bray Leeds 2"

★ *Specialists in the repair of*
REINFORCED CONCRETE STRUCTURES
ETC., also
LININGS FOR STEEL BUNKERS

GUNITE
CONSTRUCTION CO. LTD
WESTERN HOUSE, HITCHIN, HERTS.
TELEPHONE HITCHIN 4371

more space..
The modern small Cooker, complete in every detail, giving family capacity within the confined space of Kitchenettes and Flats.
"Dainty Queen"
REGISTERED
High Grade, rigid construction, proved in other "Dainty" models, establishes the "Queen" in a class alone.
Supplied also with platerack and splash back.
Approved and adopted by leading gas boards.
. . in small kitchens
R. RUSSELL & SONS
TRIPLEX FOUNDRY · TIPTON · STAFFS.

Agents for Scotland, Northern Ireland & Northern Gas Board
JAMES R. THOMSON & CO., LTD., 41, YORK STREET, GLASGOW C.2.

CLAY CROSS

(IRON & FOUNDRIES)
LIMITED

Manufacturers of

SPUN IRON PIPES

VERTICALLY CAST IRON PIPES

SPECIAL CASTINGS

BOLTED GLAND TYPE FLEXIBLE JOINTS
IN ALL SIZES from 7″ to 18″ Dia.

CLAY CROSS - DERBYSHIRE

Telephone: CLAY CROSS 2151 **Telegrams: JACKSON, CLAYCROSS**

Gas Fittings

TO YOUR SPECIAL REQUIREMENTS

We are specialists in the manufacture of all types of Brasswork used in the Gas Industry. Domestic cookers, waterheaters, drying cabinets, canteen cooking apparatus, etc., throughout the world are equipped with "Messenger" Brassfittings.

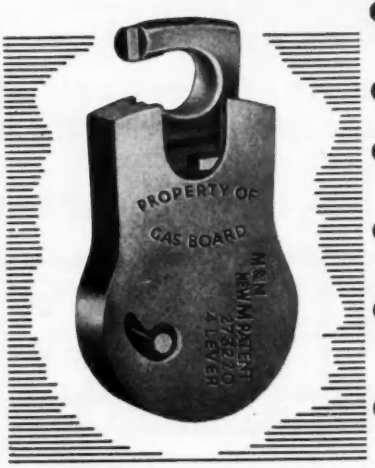
Cooker Taps, Thermostats, Regulators, Main Cocks, Fire Injectors, Machined Components to your own requirements.

SEND FOR ILLUSTRATED LEAFLET G3.

MESSENGER & SONS
TELEPHONE SPRINGFIELD 4491 (BIRMINGHAM) LIMITED BIRMINGHAM 11 · ENGLAND GRAMS & CABLES MESSENGERS BIRMINGHAM

M & M PATENT METER LOCKS

use the STRONGEST, SAFEST METER LOCK



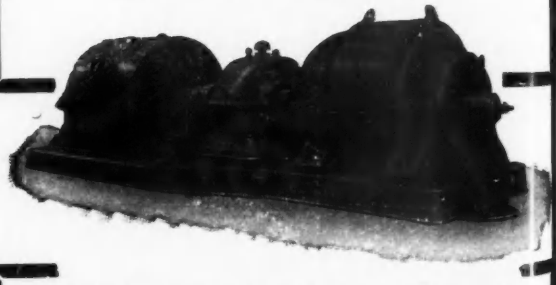
- **DON'T** buy locks you m… have to scrap in a fe… years
- **DON'T** look only at the i… tial cost
- **DON'T** think only of t… present time; loo… to the future
- **DO** remember that goo… quality is cheapest … the long run
- **DO** take our word for … that our workma… ship is consistent… good
- **DO** profit by others' e… perience and … M. & M. Locks … protect your mete…

H. MITCHELL & CO.
36, 38, NEW CHARLES STREET, LONDON, E.C.

TURBO-COMPRESSORS & EXHAUSTERS FOR AIR AND GAS

★ ★ ★

We build a complete range of Compressors & Exhausters for air and GAS, suitable for all purposes connected with the GAS industry, including Turbo-Compressors for large capacities, as illustrated below



WRITE FOR PAMPHLET No. 1018 GIVING PARTICULARS—

REAVELL & CO., LTD.,
RANELAGH WORKS, IPSWICH.
Telegrams: REAVELL, IPSWICH Telephone: 2124 & 5.

The Key to Efficient Steam Raising

CONTROLLED FLAME BOILERS LTD., THERMAL HOUSE, 10a PARSONS GREEN, LONDON, S.W.6

WALTER KING SERVICES

PERIODICALS . . .

GAS JOURNAL. *(Weekly.* Wednesday, By Post, **1s. 8d.)**

The "Gas Journal" has existed as an integral part of the Gas Industry since 1849. Unbiased policy, technical knowledge, accuracy and reliability combine with an extensive news service and modern make-up to make the Journal the leading Gas Industry newspaper.

Annual Subscription (including a copy of the "Gas Journal" Calendar and Directory): Home and Empire, **60s.** ; Foreign, **70s.**

GAS SERVICE AND DOMESTIC COKE.

(Monthly. By Post, **1s. 11d.)**

"Gas Service and Domestic Coke" is the specialist magazine for the Sales and Service personnel of the Industry. It covers all aspects of gas service from the holder to the burner and contains a special large section each month devoted to the utilization of coke. In addition to sound editorials, news items and specially contributed articles, "Gas Service and Domestic Coke" also reports in the fullest possible manner the activities of the numerous Salesmen's Circles, and Solid Fuel Bodies.

Annual Subscription : Home and Empire, **18s.** ; Foreign, **22s. 6d.**

BOOKS and ANNUALS . . .

Some current works covering the manufacture, distribution, and sale of gas are :—

KING'S MANUAL OF GAS MANUFACTURE. Now being issued in 10 self-contained sections. Sections available and prices on application.

MANUAL OF GAS FITTING. By R. N. Le Fevre. **30s.**

GAS DISTRIBUTION ENGINEERING. By R. N. Le Fevre **22s. 6d.**

DOMESTIC UTILIZATION OF GAS. By Smith & Le Fevre **20s.**

High Pressure Gas Main Construction (Restall), **10s. 6d.**

ANNUALS:—

"Gas Journal" Calendar and Directory, 25s. ; "Gas Service" Pocket Book 5s.

BINDING . . .

In addition to permanently binding subscribers' journals, (particulars and prices for which we shall be pleased to give on application) we can supply TEMPORARY BINDERS for the Gas Journal, Gas Service and King's Manual of Gas Manufacture, thus enabling readers to *bind their copies as received.* The danger of mislaid or damaged copies is eliminated.

Gas Journal temporary binder } . . . . . **13s. 3d.** each inc. postage.
Gas Service ,, }
King's Manual ,, ... **9s. 9d.** each inc. postage.

PHOTOGRAPHY . . .

Walter King Photographs specialize in Gas Industry photography of every description—work in progress series, plant, appliances, showroom displays, exhibition stands, social and educational visits of all kinds. Tours for various areas of the country can be arranged. First class photography at competitive rates. Full particulars on application.

WALTER KING LTD., 11 BOLT COURT, FLEET STREET, LONDON, E.C.4

FLEet Street 2236-7.

Chattanooga Choo-Choo?

Although, at first glance, this specimen of pipework gives the impression of a lunar locomotive designed for travel on the Copernican Crater railway, it is in fact a 42-inch bore header tank, with one 18-inch and six 24-inch bore branches forming part of a water system for the St. Annes Board Mills Co. Ltd., Bristol, designed, fabricated, tested and installed by the BRISTOL PIPING CO. LTD.

A COMPLETE PIPEWORK SERVICE

Available to engineers and contractors. Includes preliminary consultation and technical advisory service—the measurement, drawings, manufacture of pipework and ancillary equipment, installation, testing and regular survey and maintenance if required.

The Bristol Piping Company Ltd

BEDMINSTER : BRISTOL

Telephone: 63913 and 64841.

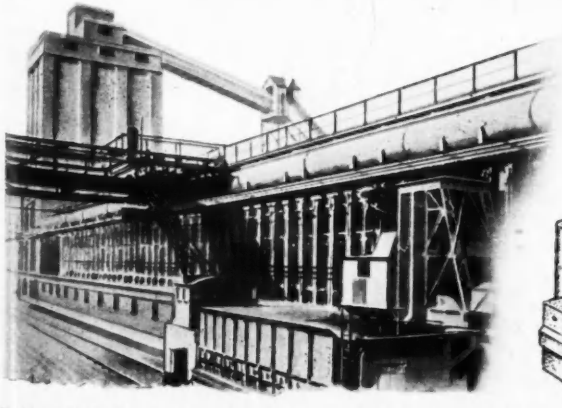
London, 10 Norfolk Street, W.C.2. Manchester, 466 Royal Exchange, 2

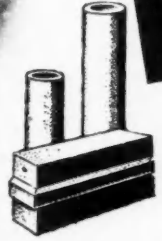
Telephone: Covent Garden 0315/6/7. *Telephone: Deansgate 5131/2.*

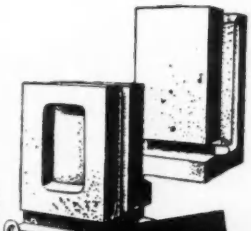
SPECIALISTS IN: HIGH AND LOW-PRESSURE PIPEWORK OF ALL TYPES, HEAT EXCHANGE EQUIPMENT, JACKETED VESSELS, HEADERS, FABRICATED STEELWORK and WELDED TUBULAR STRUCTURES.

Scotland's Leading Manufacturers

of FIREBRICKS *for the* GAS INDUSTRY







1833 GLENBOIG 1956

GLENBOIG

42/44% Al_2O_3
GLENBOIG A.I
GLENBOIG A.I CROWN

36/38% Al_2O_3
GLENBOIG
GLENBOIG CROWN
CASTLECARY

34/35% Al_2O_3
DYKEHEAD GEM

THE GLENBOIG UNION FIRE CLAY CO. LTD., GLENBOIG, LANARKSHIRE, SCOTLAND

EXPORT AGENTS: GENERAL REFACTORIES LTD., GENEFAX HOUSE, SHEFFIELD, 10

121

Foliac

GRAPHITE PRODUCTS LTD.
LONDON, S.W.11.

THOMAS BUGDEN & CO.
India-Rubber and Airproof Manufacturers and General Contractors.
LARGEST MANUFACTURERS OF GAS MAIN BAGS.
Telegrams—"AIRPROOF, BARB, LONDON." Telephone—6147 CLERKENWELL

Contractors to H.M. Government

Gas Bags for Repairing Mains

PATENTEES OF THE
DENMAR BAG
Impervious to Main Liquor and Climatic Influences.

Round or Cylinder Shape.

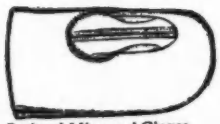
Pull-through and Expanding MAIN STOPPERS.

All types of INDIA-RUBBER BOOTS.

DRAIN RODS AND WHALE-BONE BRUSHES.

HOSE AND TUBING FOR ALL PURPOSES.

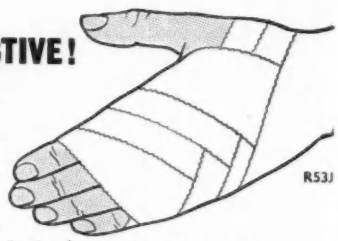
Contractors' & Miners' Woollen Jackets, Trousers, Hats, &c.


Stokers' Mitts and Gloves of every description.

244, Coswell Road, LONDON, E.C.1.

OXIDE
DUTCH AND DANISH BOG ORE
SPECIALLY ACTIVATED OXIDE OF IRON
Oxide supplied on loan or sale outright
Highest prices paid for Spent Oxide
Send your enquiries to
GAS PURIFICATION LIMITED
PALMERSTON HOUSE, BISHOPSGATE, LONDON, E.C.2
Telegrams: "Purification, Stock, London" Telephone: London Wall 7938/9 & 7930

NON-PRODUCTIVE!


R53J

Dermatitis, production's greatest enemy, can soon put skilled hands out of action. Rozalex is the proved safeguard against this risk. For over 25 years Rozalex have specialised in barrier creams for industry. They have provided the answer to most industrial skin irritants. Their full technical resources and experience are at *your* disposal on request to: Rozalex Ltd., 10 Norfolk Street, Manchester 2.

ROZALEX BARRIER CREAMS

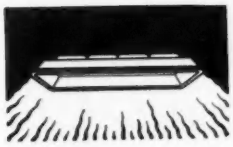
Group of three condensers with Cylindrical Shells and detachable ends.

ENGINEERS TO THE
GAS AND ALLIED INDUSTRIES

We invite your enquiries whether they be for reconstruction work, extensions or entirely new installations.
We have 65 years of specialised experience.

Rileys of Batley

A. J. Riley & Son Ltd., Victoria Works, Batley, Yorkshire. Telephone: BATLEY 657 (3 lines) Telegrams. BOILERS BATLEY



Price Reduction

HARRIS
ENGINEERING CO LTD

GAS INFRA-RED RADIANT HEATERS

(SCHWANK PATENT)

Harris Engineering Co., Ltd., are pleased to announce substantial reductions in the prices of their range of Gas Infra-Red Radiant Heaters. This comprises wall mounting types and horizontal suspension types of all sizes. The Harris service includes advice based on our many years' technical experience and installation work can be undertaken when required. There are Harris representatives throughout the country.

NEW PRICE LISTS ON REQUEST

Have you received your copy of the NEW PRICE LIST or would you like extra copies? Information gladly sent on request.

HARRIS ENGINEERING CO. LTD.,
YORK WORKS, BROWNING ST., LONDON, S.E. 17

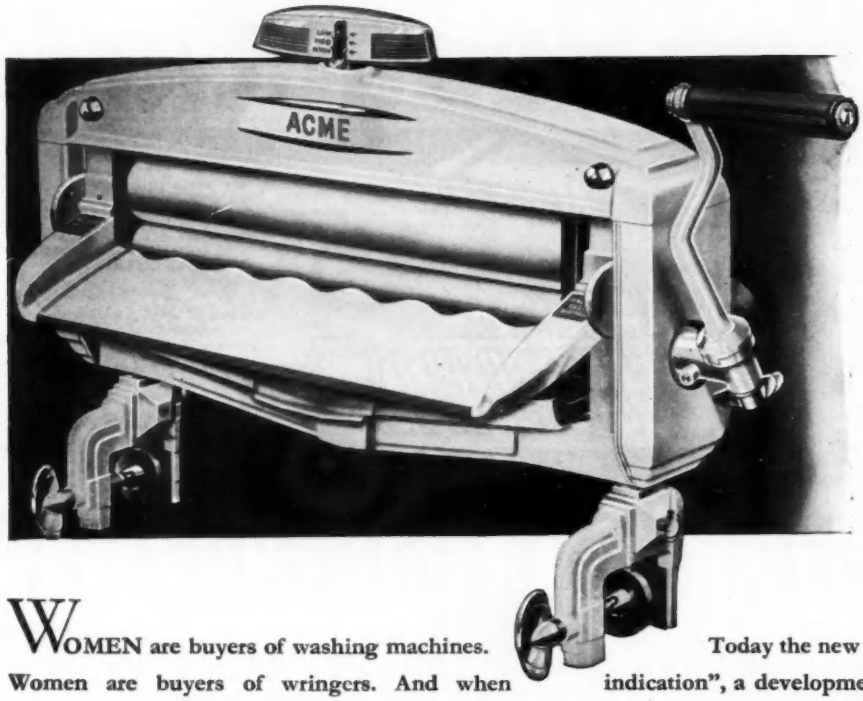
Telephone : RODney 3835/6/7

and at

GLASGOW · MANCHESTER · BIRMINGHAM · NEWCASTLE-ON-TYNE · LEEDS · BRISTOL & COLERAINE (N. IRELAND)

FWS

When washing machines are Acme-fitted **then** women know they're buying the best . . .



WOMEN are buyers of washing machines. Women are buyers of wringers. And when women think of wringers they think of the Acme. So when your machines are Acme-fitted your customers know that they must be, like the Acme, the best on the market.

Seventy years of good, solid British manufacturing, skill, research, and experience stand behind each Acme—and generations of women know this to be true. Acme is the perfect expression of real and continuous progress in the history of wringing. Thus, every feature for which Acme is famous, has sprung from a known need; has been tested, tried and found successful before it leaves the factory.

Today the new Acme has "pressure indication", a development which, by assuring the correct pressure for every kind of fabric, takes the guesswork out of wringing. Silks, cottons, woollens, linens, now receive exactly the right pressure needed to extract water, expel embedded dirt and preserve the life of each fabric. Thus wringing is made simpler and easier.

Acme does a better job, lasts longer and gives the best results. That's why Acme's reputation is world wide. That's why more than four million women have chosen an Acme in preference to all others. That's why, when your washing machines are Acme-fitted, women know they're buying the best.

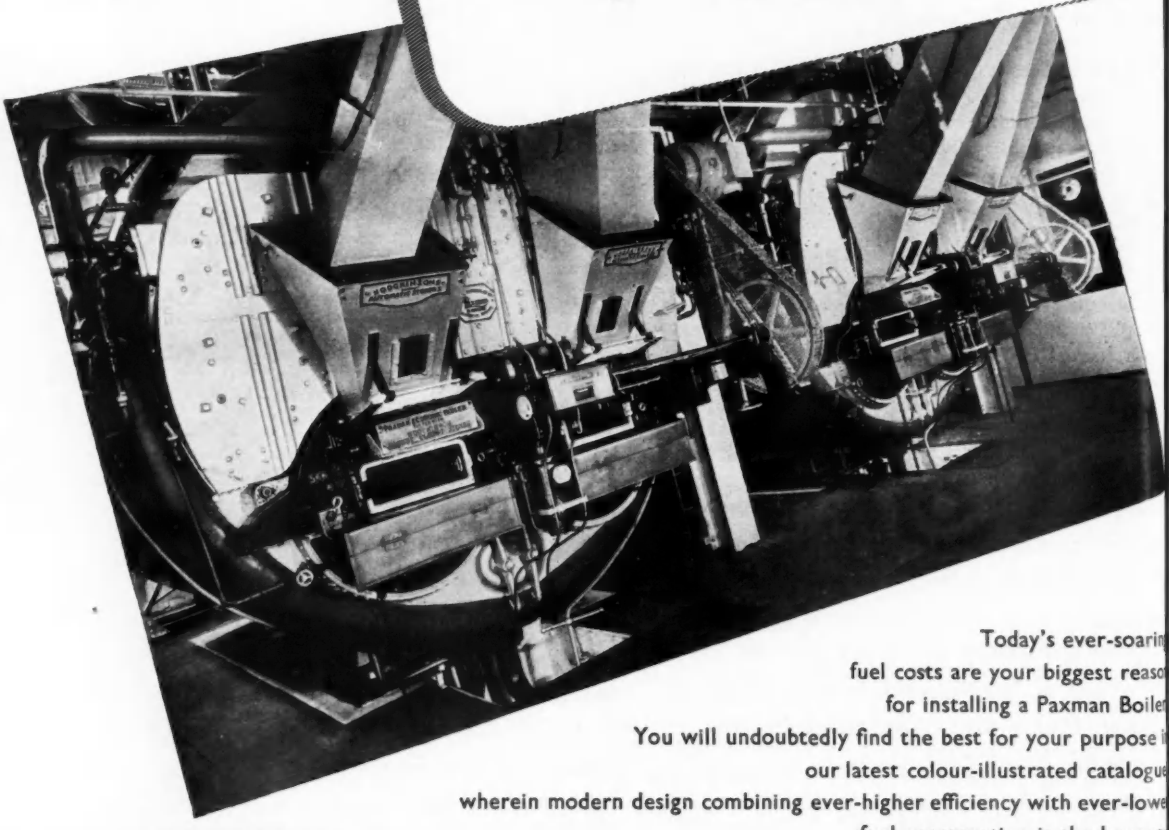
ACME WRINGERS LIMITED DAVID STREET GLASGOW SE

INDEX TO 'JOURNAL' ADVERTISERS

	Page
A	
A.C.E. Machinery Ltd.	698
Acme Wringers Ltd., ...	684
Aerogen Co. Ltd.	641
Aerograph Co. Ltd.	632
Airsonic Ltd.	676
Alder & Mackay Ltd.	630
Allan Taylor (Engineers) Ltd.... ...	675
Ashmore, Benson, Pease & Co. ...	658
Associated Lead Manufacturers Ltd.	638
B	
Bale & Church Ltd.	782
Bayley, Thos., (Great Bridge) Ltd. ...	780
Begwaco Meters Ltd.	735
Blakeley, Firth, Sons & Co. Ltd. ...	623
Bray, George, & Co. Ltd.	676
Bristol Piping Co. Ltd.	681
British Vacuum Cleaner & Engineering Co. Ltd.	640
Brown, J., & Co. Ltd.	780
Bugden, Thos., & Co.	682
C	
Cambridge Instrument Co. Ltd. ...	750
Clay Cross (Iron & Foundries) Ltd. ...	677
Clayton, Son & Co. Ltd.	648
Clifford Engineering Co. Ltd. ...	780
Cockey, Edward, & Sons Ltd. ...	656
Controlled Flame Boilers Ltd. ...	679
Cort, Robert, & Son Ltd.	726
Crone & Taylor Ltd.	649
Crosby & Co. Ltd.	cover II
Crossley Bros.	650
D	
Davey, Paxman & Co. Ltd.	686
Demolition & Construction Co. Ltd....	645
Dempster, R. & J., Ltd.	617
Dempster, Robert, & Sons Ltd. ...	732
Derbyshire Silica Firebrick Co. Ltd....	644
Diaphragm & General Leather Co. Ltd.	652
Donkin (The Bryan) Co. Ltd.	cover II, 647
Drakes Ltd.	639
E	
E.B. Refractory Cement Co. Ltd. ...	641
Electric Construction Co. Ltd. ...	659
Electroflo Meters Co. Ltd. ...	*facing p.* 769
Electrolux Ltd.	651
Elliott Bros. (London) Ltd.	712
Evered & Co. Ltd.	674
Ewart Chainbelt Co. Ltd.	780
F	
F.C. Construction Ltd.	627
Fisher & Ludlow Ltd.	624
Flavel, S., & Co. Ltd.	744
Franki Compressed Pile Co. Ltd. ...	637
G	
Gas Purification Ltd.	682, 780
Gibbons (Dudley) Ltd.	625
Glenboig Union Fireclay Co. Ltd. ...	681
Glover, Geo., & Co. Ltd.	750
Glover, Thomas, & Co. Ltd.	669, 688
Godfrey, Sir George & Partners (Industrial), Ltd.	640
Goodall, Clayton, & Co. Ltd. ...	784
Graphite Products Ltd.	682
Green & Boulding Ltd.	780
Gunite Construction Co. Ltd. ...	677
H	
Harris Engineering Co. Ltd.	683
Harvey, G. A., & Co. (London) Ltd.	643
Hayward Tyler & Co. Ltd. ...	cover IV
Holmes, W. C., & Co. Ltd. ...	699, 783
Hopkinsons Ltd.	667
Howden, James, & Co. Ltd.	756
Humphreys & Glasgow Ltd.	657
I	
I.C.I. Ltd. (Metals Division) ...	672
Ideal Boilers & Radiators Ltd. ...	633
Inertol Co. Ltd.	654
J	
Jenkins, W. J., & Co. Ltd.	661
K	
Keelavite Rotary Pumps & Motors Ltd.	758
Keith Blackman Ltd.	784
King, Walter, Ltd. ...	680, 780, 781, 782
Kleenoff Co.	676
L	
Lee, Howl & Co. Ltd.	652
Lind, Peter, Ltd.	665
Lionweld Ltd.	618
M	
MacLellan, Geo., & Co. Ltd. ...	674
Magnetic Valve Co. Ltd.	646
Main, R. & A., Ltd.	718
Main Water Heaters Ltd.	710
Meltham Silica Fire Brick Co. Ltd. ...	626
Messenger & Sons (Birmingham) Ltd.	678
Meters Ltd.	755
Mitchell, H., & Co.	678
Murex Welding Processes Ltd. ...	748
N	
National Benzole Co. Ltd.	722
National Enamels Ltd.	664
Newton Chambers & Co. Ltd. ...	700
Nu-Swift Ltd.	761
P	
Parkinson & Cowan (Gas Meters) Ltd.	634, 635
Parkinson Stove Co. Ltd.	764
Peart, E., & Co. Ltd.	620
Peckett & Sons Ltd.	737
Power Gas Corporation Ltd.	658
Press, William, & Sons Ltd. ...	671
R	
Radiant Heating Ltd.	663
Radiation Ltd.	762, 763
Reavell & Co. Ltd.	678
Riley, A. J., & Son Ltd.	682
Robinson, J. H., & Co. (L'pool) Ltd.	642
Rozalex Ltd.	682
Russell, R., & Sons	677
S	
Salter, T. E., Ltd.	687
Sawyer, Geo. E., Ltd.	780
Scientific & Projections Ltd.	653
Sigma Instrument Co. Ltd.	675
Simon-Carves Ltd.	655
Simon, Richard, & Sons Ltd. ...	654
Smith Meters Ltd.	738
Spencer Bonecourt-Clarkson Ltd. ...	673
Sperryn & Co. Ltd.	667
Stanton Ironworks Co. Ltd.	736
Staveley Iron & Chemical Co. Ltd. ...	636
Stewart & Gray Ltd.	666
Stewarts & Lloyds Ltd.	757
Stillite Products Ltd.	662
Stringer Bros.	780
Sugg, Wm., & Co. Ltd.	622
Sutherland, A. G., Ltd.	650
T	
Tangyes Ltd.	628, 629
Thermic Equipment & Engineering Co. Ltd.	631
Thorp, Thos., & Co. Ltd.	673
U	
Underpressure Engineering Co. Ltd.	784
United Kingdom Construction & Engineering Co. Ltd.	660
Unit Superheater & Pipe Co. Ltd. ...	664
V	
Visco Engineering Co. Ltd.	666
W	
Walter King Ltd. ...	680, 780, 781, 782
Walker, C. & W., Ltd. ...	cover I
Waller, George, & Son Ltd.	668
West's Gas Improvement Co. Ltd.	717, 718
Westwood & Wrights Ltd.	619
Whitley Moran & Co. Ltd.	662
Whittaker Ellis Ltd.	621
Willey & Co. Ltd.	cover III
Wilson, George, (Gas Meters) Ltd. ...	670
Winn & Coales Ltd.	643
Wood, Hugh, & Co. Ltd. ...	*facing p.* 768
Woodall-Duckham Construction Co. Ltd.	697
Appointments Vacant	778, 779, 780
Educational	780
Patents	780
Publications	780

'ECONOMIC' by name

...ECONOMIC by nature



Today's ever-soarin
fuel costs are your biggest reas
for installing a Paxman Boile
You will undoubtedly find the best for your purpose i
our latest colour-illustrated catalogue
wherein modern design combining ever-higher efficiency with ever-lowe
fuel consumption is the keynot
Write for it toda

Paxman

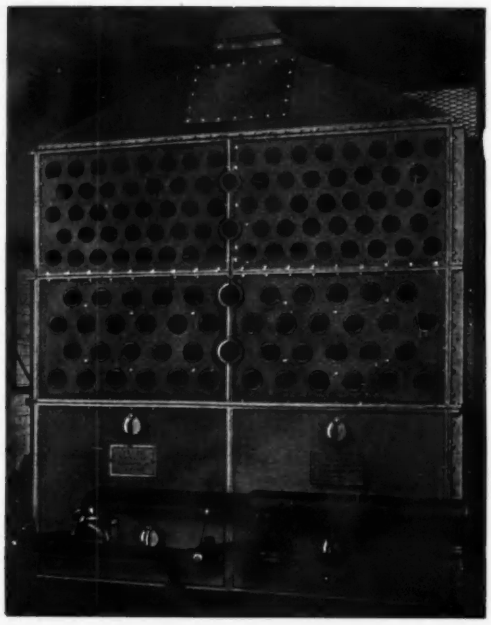
ECONOMIC · ULTRANOMIC · STEEL SECTIONAL · PACKAGED WATER TUB

DAVEY, PAXMAN & CO LTD
COLCHESTER · ENGLAND
Telephone: Colchester 5151
Telegrams: Paxman, Colchester
Telex: 27-2678

Boilers

MAKERS ALSO OF DIESEL ENGINES, ROTARY VACUUM FILTERS AND HEAVY FABRICATION WO

VENTILATE AS YOU HEAT



The VOLEX

REGISTERED TRADE MARK

WARM AIR SYSTEM

is recognised as the most efficient and economical system of Heating and Ventilation for Stores, Offices, Factories, Workshops and all buildings where a pleasant equable atmosphere—essential to health and efficiency—is required. It maintains an even temperature and draughtless ventilation all the year round, and the air in the building can be changed as often as desired according to the processes carried on. The heaters are made either for gas-firing, hand-firing, worm feed stokers or oil firing.

Enquiries invited by the Sole Makers:—

T. E. SALTER LTD. TIPTON, STAFFS.
TELEPHONE: TIPTON 1657/1658.

Gas Journal

VOL. 286 NO. 4847 June 6, 1956

108TH YEAR

MANAGING DIRECTOR: Clifford A. King

EDITOR: Geoffrey W. Battison

TECHNICAL EDITOR: Charles J. P. de Winton, T.D., M.A., M.Inst.Gas E., M.Inst.F.

Published by Walter King Limited,

11, Bolt Court, Fleet St., London, E.C.4

Telephone: FLEet Street 2236-7 Telegrams: Gasking, Fleet

CONTENTS

INSTITUTION OF GAS ENGINEERS
93rd ANNUAL GENERAL MEETING

H.R.H. The Duke of Edinburgh—*Frontispiece* 689
The Meeting—As We Saw It 690
Visits Supplement 701
Institution Benevolent Fund 719
Results of the S.B.G.I. Golf Meeting 719
President's Luncheon 720
Post-war Development of East Greenwich Works. By C. Stott. Followed by Discussion 723
Domestic Utilization of Gas and Coke. By L. W. Andrew. Followed by Discussion 730
Production and Supplies in the South East Area. By R. Prince and J. A. Gould. Followed by Discussion 741
Consideration and Assessment of Coke Dry Cooling. By A. E. Morris. Followed by Discussion 747
Liquid Methane. By J. Burns and L. J. Clark. Followed by Discussion 754
Problems of the Long Distance Transmission of Gas in Germany. By Dr. F. Gummert. Followed by Discussion 770
Domestic Coke Preparation at Kensal Green. By G. F. I. Roberts and R. S. Rodick. Followed by Discussion .. 774
Personal 779
Birthday Honours 779

PUBLISHERS' NOTICE, SEE PAGE 781

Thomas Glover is the name

. . . *for industrial meters*

Meters for industrial installations are a T.G. speciality. Size of meter is no obstacle—we pride ourselves on being able to supply any capacity required. Why not consult us about your requirements?

. . . *for meter repairs*

If a meter can be repaired T.G.s can repair it! Our Repair Service is backed by years of experience, and all repairs are carried out by craftsmen, skilled at their work. Let us handle your repairs — industrial or domestic.

THOMAS GLOVER & CO. LTD.

GOTHIC WORKS, ANGEL ROAD, EDMONTON, LONDON and BRANCHES

TG23

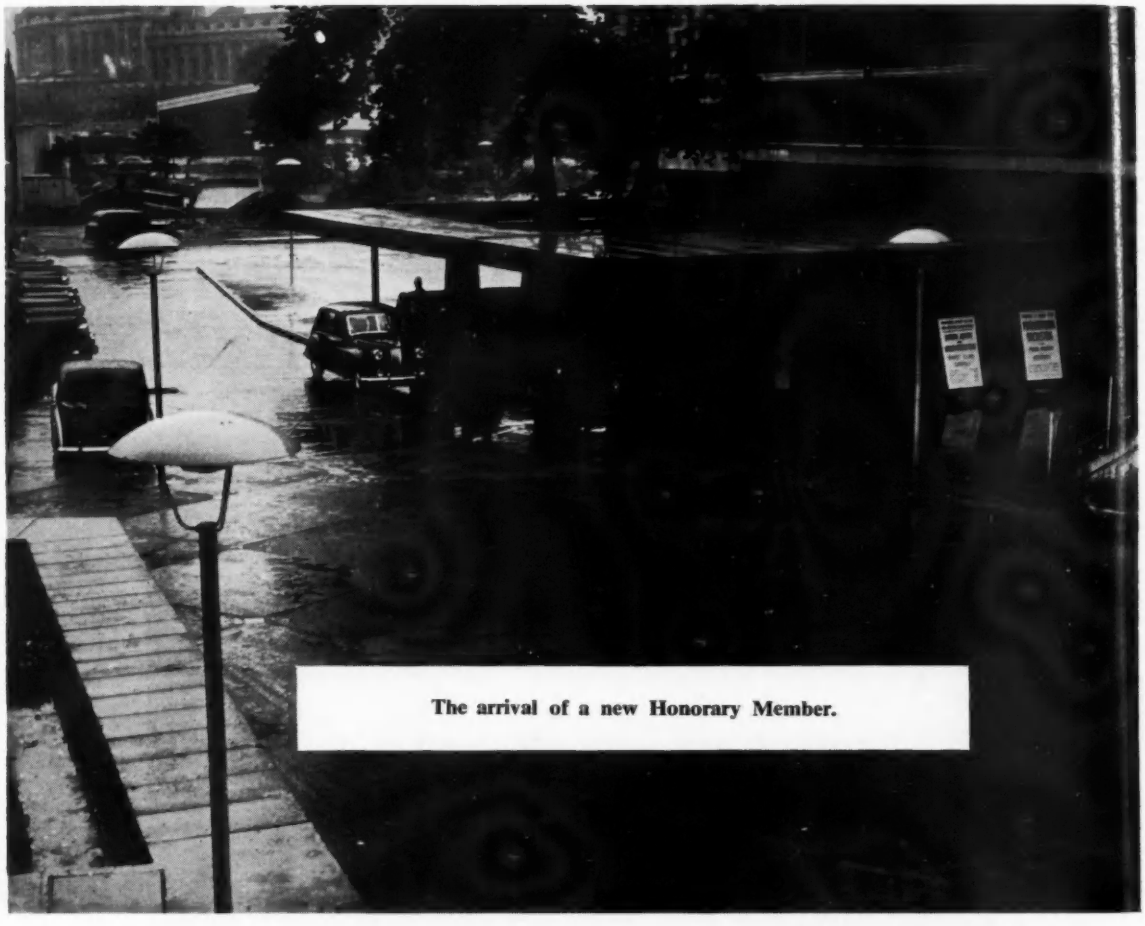
Gas Journal

INSTITUTION NUMBER

VOLUME 286. No. 4847. JUNE 6, 1956. 108th YEAR

H.R.H. THE DUKE OF EDINBURGH, K.G., K.T.

who honoured the 93rd Annual General Meeting of the Institution of Gas Engineers with his presence and by his acceptance of a Scroll of Honorary Life Membership.



The arrival of a new Honorary Member.

The Meeting . . . as we saw it

MR. W. K. HUTCHISON will have every reason to remember with pleasure his year of office for it has been one of the most notable in the Institution's long and distinguished history. Its climax, the 93rd Annual General Meeting, on May 29-June 1, was exceptional for two reasons: The presentation of a scroll of honorary life membership to the Duke of Edinburgh; and the holding of the meeting in the superb surroundings of the Festival Hall, in which the President's Board has a very particular interest. The presence of such a Royal visitor was in itself enough to set the seal of success on the meeting, but even without the glamour and pleasure of this event the meeting would have been memorable for the quality and variety of the technical contributions and the excellence and interest of the visits.

It was just on noon when the sleek Austin deposited the Duke at the almost deserted entrance to the Festival Hall, where he was welcomed by the President, Sir Harold Smith, and the industry's 'top brass.' Prolonged applause greeted his appearance on the platform where Mr. Hutchison expressed the Institution's appreciation of the honour done them by the Duke's acceptance of the scroll recording his election as an honorary life member.

'We are an old Institution,' continued the President, 'for this is our 93rd annual meeting, and we serve an industry which is approaching its 150th year of active existence. Nevertheless, while priding ourselves on our long traditions, we hope to be worthy of the trust you place in our future. We will hope to merit that trust not by relying on achievements of the past but by seeking always to improve the service which we give to a public which relies on us for a continuous supply of fuel in a convenient and accessible form. We firmly believe that we can improve and expand that service by the application of the most modern scientific development.'

Characteristic Humour

Speaking with characteristic informality and humour, the Duke, accepting the scroll, said that for a number of reasons he considered himself a very suitable recipient of this honour, although he was not an engineer of any kind. He was sorry to say that for years, like a great many other citizens, he suspected he just accepted gas in much the same way as one accepted electricity or cows. It was only when he had visited the Ponders End gasworks in 1953 that he really gained any idea of the very complicated and comprehensive system of distribution of gas and the problems of manufacture on a commercial scale. That visit had been an amusing coincidence in that exactly 97 years previously to the day Prince Alfred, who later became the Duke of Edinburgh, had paid a similar visit to the Brick Lane gasworks. 'Now here I am—exactly 100 years after he paid his visit to the Brick Lane gasworks.'

'A Credit—and a Headache'

It was during that visit to Ponders End and during other visits that he first gained any idea of how widely gas was used, but it was when he looked through the President's address that he first discovered what really fantastic figures we had in this country compared with the rest of Europe. This enormous production was at the same time, he thought, a credit to the gas industry and to this Institution, but he imagined that it must also be their greatest headache because suitable coal was, after all, becoming

very difficult to get, and he gathered that it was becoming more expensive every minute! Also he imagined that the competition from other methods of heating and cooking was warming up too! Therefore, he was sure that all gas users would be encouraged to know that the industry was constantly introducing new ways and means of producing gas more cheaply. A great deal of this research was done under the auspices of the Institution, and he wished it every success.

Flexibility of Outlook

The gas industry's history had shown clearly that it had always the ability to adapt itself to changing conditions and new ideas. Judging by the papers which were to be read at the meeting and by the President's address, it still had that flexibility of outlook and the same adaptability of technique. He imagined that that was nothing like as easy as it sounded in an industry which was now very nearly 150 years old and which was, in fact, the first to distribute energy continuously to individual consumers. However, there must be a great deadweight of old-fashioned equipment. Even the liveliest industries had an excuse for getting a bit set in their ways after a certain period of time. That was why he would like every person working in the gas industry to be aware of the subject discussed at this meeting. He could imagine nothing more stimulating or encouraging for them than subjects such as gas from oil, the complete gasification of coal, research in natural gas, the importation of liquefied gas which would otherwise go to waste, and the President's scheme for whole house heating. All these offered new possibilities to the industry and to the consumers.

Only Ourselves to Blame

Ultimately, of course, the industry depended on coal, and coal was this country's only major indigenous source of energy and the gas industry was coal's most efficient user. This meant two things: It would still be worth while making gas out of coal when it was not worth while doing anything else with it; also, the other suppliers of energy which depended on imported raw materials would now always be in the awkward position of never being quite certain of their supplies. If we could not get coal in this country, we at least only had ourselves to blame.

Referring to a remark of the President concerning the pleasure experienced by the Australian Gas Institute at the news of the presentation, the Duke said that when he went to Australia later on for the Olympic Games he was going to visit a new brown coal gasification plant at Morwell in Victoria. The gas from these works was to be piped 80 miles to Melbourne. When he and the Queen were in Australia they had visited the brown coal deposit at Yellourn. That had been a very impressive sight. The seams averaged 200 ft. in depth and were up to 560 ft. thick, and the over-burden was only 50 ft. 'I apologize if that makes some of your mouths water,' he added.

There was to be a conference at Oxford in July on the human problems of industrial communities within the Commonwealth and Empire. He mentioned this because Sir Harold Smith, the Chairman of the Gas Council, had been most sympathetic and helpful, and also because another member, Mr. Mervyn Jones, was Chairman of our advisory panel for the study tour to South East Wales, and Mr. K. E. Jones, another member, was one of the study group Chairmen. Incidentally, the study groups would be paying a number of visits to gasworks.

Concluding, the Duke said: 'I was very flattered to receive your invitation, but I will tell you that I accepted first because I am convinced that the gas industry has a great future and, secondly, because I believe that your Institution will be the most important influence in shaping that future.'

A Glow of Pride

Thanking the Duke for his address, Sir Harold Smith, Chairman of the Gas Council, said he was sure that there was not a man or woman employed in the industry who would not feel a glow of pride that the Duke should be associated with the industry which they served. Only one mistake had been made, and that was in making him an Honorary Member. After listening to his address he could well have taken the examinations and become a full Member!

Earlier, during the business meeting, the President had welcomed representatives and members from overseas who included Mr. J. E. Logan, from Sydney, Past President of the Australian Gas Institute; M. R. H. Touwaide, from Brussels, General Secretary of the International Gas Union and Secretary of the Belgian Gas Association; M. G. Nerct, from Paris, the President, and M. A. Bertin, from Paris, of the French Gas Association; Mr. O. Kohl, from Frankfurt, of the German Gas Association; Dr. G. Vitali, from Milan, of the Italian Gas Association; Mr. P. J. de Klerk, from Ijmuiden, of the Netherlands Gas Association; and Mr. Max Schenker, from Neuchatel, President of the Swiss Gas Association. The overseas members who were present were Mr. R. G. Langford, Mr. L. F. Nicholson, Mr. N. V. Steenstrup and Mr. R. J. S. Thompson.

He said that the Institution had had a disappointment in that Dr. Boselli, President of the International Gas Union, who, until the very last moment had expected to attend the meeting, was prevented by illness from doing so.

Dr. W. T. K. Braunholtz, the Secretary, then read a telegram from Dr. Boselli expressing his good wishes for the meeting and the reply which the President had sent.

The Minutes of the 92nd Annual General Meeting, held in Southsea on May 24-27, 1955, and of the Special General Meeting (being the 21st Autumn Research Meeting) held in London on November 22 and 23, 1955, were taken as read and confirmed.

The President announced that on behalf of the Institution, the Secretary had sent a telegram conveying the loyal greetings of members of the Institution to Her Majesty the Queen. He then moved that the 93rd Annual Report of the Council of the Institution of Gas Engineers for the year 1955-56 and the Accounts for the year 1955, be taken as read and adopted. Mr. J. H. Dyde seconded the motion and congratulated the Council on their work, and the Finance Committee, in particular, for their good housekeeping.

The Duke of Edinburgh examines with interest the scroll recording his Honorary Membership of the Institution.

Election of Officers

The Secretary announced the results of the ballot for the election of Officers, auditors and ordinary members of Council:

President: Sir Henry F. H. Jones, M.B.E., M.A., Deputy Chairman, the Gas Council.

Vice-President: Mr. Edward Morgan Edwards, Member, Wales Gas Board.

Auditors: Sir Harold C. Smith, K.B.E., D.L., Chairman of the Gas Council, and Mr. Peter D. Davey, F.C.A.

Hon. Secretary: Mr. G. E. Currier, O.B.E., Deputy Chairman, North-Eastern Gas Board.

Ordinary Members of Council: Mr. T. C. Battersby, M.B.E., General Manager, Watford Division, Eastern Gas Board; Mr. A. R. Bennett, General Manager, Research and Development, Radiation, Ltd., Birmingham; Mr. L. P. Ingram, M.B.E., M.SC., Chief Engineer, South Western Gas Board; and Mr. J. Powdrill,

Although the platform party did not sound much like the orchestra or choir which they resemble in this photograph, at least it can be said that proceedings were conducted with the greatest harmony.

M.B.E., General Manager and Engineer, Cardiff Undertaking, Wales Gas Board.

District Members of Council

The names of the District Members of Council nominated by the District Sections of the Institution and affiliated District Gas Associations for the year 1956-57 were announced as follows: Mr. J. R. Cleator (South Bank), North of England; Mr. A. Cole (Hull), British Junior Gas Associations' Joint Council; Mr. J. Corrigan (Blaby), Midland; Mr. G. Dougill, M.SC. (London), London and Southern; Mr. W. M. Gledhill (Stirling), Scottish; Mr. J. F. Lloyd (Wrexham), Wales and Monmouthshire; Mr. J. M. McLusky (Wakefield), Manchester and District; Dr. A. Marsden, M.B.E., M.SC. (Bristol), South Western; Mr. P. J. Sheehan, B.E. (Cork), Irish; Mr. R. C. Wardell, B.SC. (Eng.) (Boston), Eastern.

The Chairman proposed that scrutineers of ballots for the ensuing year should be Mr. T. C. Battersby, Mr. A. R. Bennett, Mr. A. Cole and Mr. G. Dougill. Mr. J. Corrigan seconded the motion, which was carried.

The Premier Award

The President said that he now came to the duty which was as pleasant as any which he had had in this year of office or as pleasant as any he ever expected to be charged with—the duty of the presentation of the Birmingham Medal, 1956, to Sir Harold C. Smith. Mentioning Sir Harold's celebration this year of his fiftieth year of service in the gas industry ('a notable record for any man but most remarkable in a man looking so young as Sir Harold looks'), the President said that it was appropriate that Sir Harold was born and had his early education and his introduction to the gas industry in Birmingham, since the medal was named the Birmingham Medal.

Sir Harold Smith said that it gave him 'a terrific thrill,' and, commenting on the events of his 50-year service, said that today the industry was different in one very important respect. In his early days in the industry—and in the not-so-early days, too—if ever some suggestion were made for improving anything one was nearly always told, 'We have never done it like that before and we are not going to start now.' The whole atmosphere today was, 'What can each of us do to make this industry more efficient and prosperous?' With everyone working in that atmosphere, those who would live to see the next 50 years would, at the end of that time, find a far more prosperous industry than they had today.

The President then made the following awards:

Institution Gold Medal, 1955: Awarded to G. H. FUIDGE, B.SC., M.INST.GAS E., and J. R. Dewhurst, PH.D., A.R.I.C., M.INST.GAS E., for his paper on 'The Tolerance of Aerated-burner Appliances to Variations in the Combustion Characteristics of Town Gas,' read at the 21st Autumn Research Meeting of the Institution of Gas Engineers, in London, on November 22, 1955.

H. E. Jones London Medal, 1955: Awarded to L. J. Clark, B.E.M., M.SC., M.I.MECH.E., M.INST.GAS E., A.M.I.C.E., A.M.I.E.E., for his paper on 'Pumping of Liquids on Gas Works,' read at the 92nd Annual General Meeting of the Institution of Gas Engineers, in Southsea, on May 25, 1955.

Institution Silver Medal, 1955: Awarded to D. C. Elgin, A.M.I.MECH.E., ASSOC.M.INST.GAS E., for his paper on 'An Administrative Approach to Technical Efficiency,' read at a meeting of the Scottish Association of Gas Managers in Peebles, on April 22, 1955.

Institution Bronze Medal, 1955: Awarded to F. Grocott, B.SC., M.INST.GAS E., M.INST.F., for his paper on 'Oxide Purification,' read at a meeting of the Midland Junior Gas Association, in Birmingham, on April 19, 1955.

William Dieterichs Memorial Prize, 1955: Awarded to J. A. Prigg, B.SC., ASSOC.M.INST.GAS E., A.R.C.S., D.I.C., for his paper on 'Aerated Burners,' read at a meeting of the London and Southern Junior Gas Association, in London, on February 4, 1955.

Mr. Hutchison then gave his Presidential Address (published in last week's 'GAS JOURNAL' on p. 600).

Voicing the company's thanks to the President, Mr. F. M. Birks said that he had known him since his early days in

Mr. G. H. Fuidge and Mr. J. R. Dewhurst, photographed as they received the Institution Gold Medal for their paper on 'The Tolerance of Aerated-burner Appliances to Variations in the Combustion Characteristics of Town Gas,' read at the Autumn Research Meeting.

Sir Harold Smith, this year's winner of the Birmingham Medal, receives the congratulations of the President.

The Institution Bronze Medal reaches the hands of Mr. F. Grocott for his paper on 'Oxide Purification,' read to the Midland Juniors.

Mr. J. A. Prigg won the William Dieterichs Memorial Prize for his paper on 'Aerated Burners,' read to the London Juniors.

A paper on 'An Administrative Approach to Technical Efficiency,' read to the Scottish Association, won the Institution Silver Medal for Mr. D. C. Elgin.

the Research Department of the Gas Light and Coke Company in which he had been recognized as one of the most promising of the younger members of the staff. During those somewhat hectic days while searching for the solution of the gum problem, he had steadfastly advocated—as time was so important a factor—that it would be necessary to stage a mass attack, by concentrating every available person on to the work. At the same time he advised working simultaneously on as many investigations as possible. It was these methods which resulted in the speed at which the solution was obtained. His work on oil washing for benzole under vacuum was something new in the industry in so far that he alone was responsible not only for the original conception of the principles involved but also the superintendence of the complete designs, calculations, engineering and putting to work of the plants. The speed which ensued in the completion of the many installations built and put into action was most impressive. The large activated carbon plant at Beckton for benzole extraction built about the same time to German designs, was in fact only half successful in so far that due to excessive corrosion the maintenance could only be carried out while the plant was operating at about half capacity. The President had produced a most elegant design to get over the trouble which was an unqualified success.

His valuable work during the war on the manufacture of hydrogen for

Mr. G. E. Currier and Dr. J. Burns register approval as the President offers a handshake, a word of congratulation—and the H. E. Jones London Medal—to Mr. L. J. Clark for his paper on 'Pumping of Liquids on Gas Works,' presented to Institution's A.G.M. last year.

Mr. Aubrey Jones enjoys a joke with the President and two visitors from the States, Mr. W. Wood Prince and Mr. J. Murphy.

balloons was, of course, very much in the public eye and a feature of the skyscape. On his return he undertook, *inter alia*, the general reconstruction of the products works, the largest and most comprehensive ever undertaken. Now, six years later, the work is still proceeding exactly on the lines he had laid down.

The address, with its informative tables and charts, was more than timely, and would be welcomed by the whole industry as a model for such an exercise. The clarity with which the present position was summed up was most refreshing in so far that it was not hampered by any preconceived ideas.

He could not help feeling that when in passing a reference was made to the desirability of the works end pushing forward with increased sulphur removal, his modesty alone restrained him from pointing out that this most desired end could be economically and quickly obtained by using the process of benzole washing for which he himself had been so largely responsible.

Mr. M. Sinclair Gaskill seconded the proposition.

Gas in Germany

That brought us to the end of the 'business,' and Dr. F. Gummert's paper on 'Problems of Long Distance Transmission of Gas in Germany.' A member of the Directorate of the Ruhrgas Aktiengesellschaft, of Essen, Dr. Gummert showed how, at the present time, the long-distance gas industry in Germany is faced with two main problems—that more gas will be needed, and more gas must be made available to meet peak requirements. To increase supplies the Ruhrgas Company has developed the vortex-chamber process in order to gasify coal with high ash contents into a lean gas used to replace coke oven gas; it has resumed research into the almost complete gasification of unwashed coal; it proposes to carbonize coal prior to firing it in electric power stations; and it has developed underground storage.

In the discussion which followed, Mr. J. H. Dyde, Mr. E. M. Edwards, and Mr. H. D. Greenwood, all paid tribute to Dr. Gummerts' dynamic character and his modesty in describing himself as a business man rather than a technologist. As they rightly pointed out, the author's appreciation of technological developments taking place in the gas industry is 'profound and sound.'

Unfortunately, there was no time for further contributions to the discussion nor for Dr. Gummert to reply, and we therefore relaxed in the melodious hands of Ralph Downes at the Festival Hall organ before the excitement of the Duke's visit, which has already been described. After the Royal visit the morning session concluded and members repaired to the Savoy Hotel for the President's Lunch, reported on p. 720.

The President's Luncheon

After the inspiration of the morning the short journey to the Savoy Hotel for the President's Luncheon was, for some, literally a cold douche. The elements had decided to answer the gardeners' prayers and, incidentally, water the flowers on the ladies hats. However, nobody appeared to worry unduly and arrived at the Savoy, we ensured consistency by wetting the inner as well as the outer man.

Came speech time and we had an opportunity to confirm our growing confidence in the President as a first-class speaker. His little homily on the misfortunes of the gas industry Cinderella was matched only by Mr. Aubrey Jones' brilliant reply. The Minister was at pains to show that in his role of Fairy Godmother he was unlikely to indulge in any favouritism as far as gas was concerned.

After the overcast skies of the morning the weather seemed to be showing signs of improvement when we emerged: Were we to have 'Institution Weather' after all? There seemed every hope, for the sun was coming out, and a fresh new world seemed to be at our feet. Technically, too, there was a fresh new world because the first paper of the afternoon session was the paper by Dr. J. Burns and Mr. L. J. Clark on 'Liquid Methane.' This subject has lately received a good deal of attention because of the publicity given to a scheme to bring liquefied methane from the Texas oil field up the Mississippi to Chicago for use as a refrigerant and fuel in the meat packing industry connected with the stockyards, and how this scheme might be modified to enable liquefied methane to be brought to England from the Middle East oil fields and by so doing tap the very large quantities of natural gas that are going waste in these areas. Dr. Burns, with his usual vitality, soon warmed to his subject and in the presentation of the paper, which was illustrated by lantern slides, gave a clear and concise account of the present state of experience and technological 'know-how' existing in America today.

A Welcome Visitor

The discussion was opened by a welcome visitor, Mr. Wood Prince who with some modesty described himself as neither scientist nor engineer, and hardly fit to open a discussion on a paper by anyone so well informed as Dr. Burns. But as a business man connected with the Chicago stockyards and the meat packing industry he had been closely connected with the enterprise of bringing liquid methane from Texas to Chicago. He illustrated his contribution with lantern slides, some of the most interesting of which were illustrations of the barges which had been designed to carry the liquefied gas, the arrangement of the individual compartments, the means taken to insulate these tanks, and the provision for circulating inert gases among the compartments to avoid a combustible atmosphere being formed in the neighbourhood by evaporation of the liquefied gas and the air circulating round the compartments. He also referred to the disaster at Cleveland when a storage tank containing liquefied gases had exploded with loss of life. This explosion though serious, had helped to show weaknesses in tank construction and the deterioration of metals at low temperatures.

There were a number of contributions to the discussion so that the President asked Dr. Burns if the authors would reply to the many points raised in writing after the meeting—a delay which is becoming all too common in these days due to the replacement of concise comments by satellite papers.

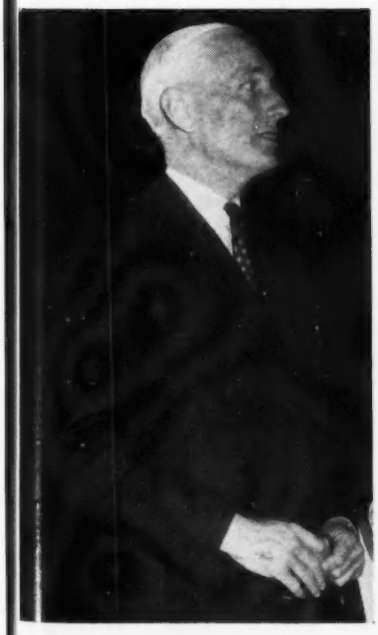
The next paper to be presented was 'The Organization and Planning of Production and Supplies in the Area of the South Eastern Gas Board,' by Mr. R. Prince and Mr. J. A. Gould. Mr. Prince, Chief Engineer of the South Eastern Gas Board, presented the paper and gave a well-sketched account of the problems with which the old South Metropolitan Gas Company and later the South Eastern Gas Board had been faced after the war. He outlined the magnitude of the scheme and showed how it involved the laying of trunk mains of large diameter from the big London stations of the South Eastern Gas Board to the surrounding countryside in Surrey and Kent. These stations could carbonize seaborne coal which could be delivered to the gasworks at a consider-

ble saving compared with the cost to inland stations. It was the aim of the Board to concentrate as far as possible in this way by making full use of the new works at Portslade for the Sussex Division, the enlarged Dover works for East Kent, including the Isle of Thanet, and the terrific potential supply that the new oil gasification plant in the Isle of Grain would create.

Among those who took part in the discussion, Mr. G. le B. Diamond, Chairman of the West Midlands Gas Board, stressed the advantage gained by the provision in the Gas Act making each board autonomous. This, he said, was a real inspiration on the part of those who framed the Act. The arrangement and organization of the South Eastern Gas Board obviously suited that Board's special layout and when the final integration was complete it would reap the full advantage., but he did not think that a similar organization, which was so very functional in character, would be particularly suitable for the conditions in the West Midlands Board. Another contributor to the discussion, Mr. W. T. Hird, of the Wales Gas Board, said he was most impressed by what the South Eastern Gas Board had accomplished, particularly because, if he compared his own efforts in Wales, they seemed like scattering spaghetti round the countryside.

Dance and Skylark

The company adjourned only to reassemble, in the sweetness of the evening, complete with their better halves, for the reception and dance. Unfortunately the Festival Hall which had served so well in the way of acoustics and general amenities during the business session proved hopelessly unsuitable for a function of this type. It was a little like dancing in a shop window with one's head in a loudspeaker. Seating accommodation was cramped and as for air conditioning . . . . we mop our brow at the very memory. However, it would take more than these handicaps—which, after all, are not unknown in other premises allegedly catering for such jollification—to put the damper on the Institution's powers of enjoyment, and, in the well-worn phrase, a good time was had by all.



Sir Henry Jones, the new President.

South Met. Memories

The first paper on Wednesday morning, by Mr. Stott, Deputy Chief Engineer of the South Eastern Gas Board, on 'The Post War Development of the East Greenwich Works', aroused a good deal of interest. In his presentation Mr. Stott went into some detail of the work involved, and how certain changes in policy had had to be made. Perhaps the most-far-reaching was the decision to abandon the traditional horizontal retort, which had so long dominated the scene at all the stations of the old South Metropolitan Gas Company. In the developments since 1947, coke ovens had taken their place, because of the high density of output on a given site and easy adaptation to mechanical handling.

The discussion which followed was opened by the Managing Director of Simon-Carves Ltd., the builders of the ovens, who stressed the different technical demands made upon the design department of his firm by the gas industry compared to those made by the metallurgical coke industry with which he was accustomed to deal, the different coals to be used and the different type of coke which the gas industry wanted. But these had all been met. Another contributor, who had served with the South Metropolitan Gas Company, caused some amusement by referring to the uncompromising attitude of the old Company to the use of electricity on the works. It had been kept out at all costs, which had implied considerable ingenuity on the part of the engineering staff to make use of other forms of easily transmissible power, notably hydraulics, the success of which was shown by this system still being employed for the charging machines. Mr. Dougill, of North Thames, was most emphatic in his praise of the decision of the Board to adopt the excellent precedent set by the building of the coke oven plant at Beckton 25 years ago by the Gas Light and Coke Company.

Coke Dry Cooling

Mr. Morris' paper on 'Consideration and Assessment of Coke Dry Cooling' which followed should be of great potential interest to both gas and coke oven engineers. In the past there have always been serious snags why one or other of the systems should not be utilized. The high capital cost of the plant, the high maintenance cost, and the absolute necessity of either similar types or alternative types of standby plant, have all discouraged the use of this form of cooling. But

Is that a mistake? Dr. J. Burns confers with Dr. W. T. K. Braunholtz.

now when the possibility of a shortage of fuel becomes a real danger and in view of the very high prices of our only indigenous fuel, this form of coke cooling should receive the attention it deserves. The most successful plants are on the Continent, especially in Switzerland which has no solid fuel supply of its own, and though teething and other troubles have been met with, this plant is still working. There are many advantages from this form of cooling, as was enthusiastically pointed out by the few but very interested members who took part in the discussion. Dr. Foxwell put forward a strong case for adopting this system if only for reasons of fuel economy, as steam could be raised for as little as one-fifth of the cost from solid fuel boilers. The coke produced could be properly screened and the breeze completely eliminated. Other speakers suggested damping the final product with a controlled amount of water to give it a moisture content of between 2% and 5%, and another contributor pointed out the difficulties involved in handling coke at 300°C. In the dry cooling systems coke was cooled from 900°C. to 300°C., but no further, and the handling of this product was most awkward and corrosive to the screens.

On Thursday morning, the session opened with the paper on 'Domestic Utilization of Gas and Coke,' by Mr. L. W. Andrew, Director of the Watson House Centre. Mr. Andrew is always an interesting speaker. His direct and human delivery leaves his audience in no doubt that here is something worth listening to and even the most somnolent are roused into a state of attention. In this paper we were not disappointed, because he put forward some convincing arguments in favour of the use of gas and coke, each in their proper rôle, in the space heating of houses and for the heating of hot water. The slot meter user may find it difficult to keep himself warm in the coldest time of the year if he depends on gas for space heating and finds he cannot meet the cost. Either he does not go in for gas space heating and so is a potential customer lost to

the Board, or else, as one contributor suggested, it is made possible for him to pay his winter gas bill over an extended period, perhaps before the really cold period sets in. Other speakers seemed very definite about the use of gas and the rôle of the gas salesman; he must get in before coke could have a chance.

The efficiency of appliances was discussed by a contributor who thought the accepted figure of about 60% and over rather optimistic. Other contributors discussed flues and flueing and stressed difficulties encountered in tall buildings, especially flats where a number of fireplaces are connected at different heights to a common chimney.

The last paper of the meeting was 'Domestic Coke Preparation at Kensal Green' by Messrs. G. F. I. Roberts and R. S. Rodick. Mr. Roberts presented the paper and pointed out how important it was to offer coke in a reasonably attractive form to potential buyers. On the whole, coke was not very attractive to would-be buyers if it was damp, contaminated with breeze, and full of shale, even if in every other respect it was technically perfect. The would-be domestic user would not buy unless presented with a well- (and consistently) graded coke of about 5% moisture which did not make a mess in the house, and it would be judged on its heating ability alone. These were the sort of problems facing the gas industry, and in their paper the authors showed what attempts are being made to overcome these difficulties at Kensal Green.

Vote of Thanks

The responsibility for proposing the traditional omnibus vote of thanks fell to Dr. H. Hollings, O.B.E., who said that for some years now these meetings of the Institution had proceeded so smoothly and so pleasantly that there was a danger of taking too much for granted. But he suggested that it would be unseemly if the company dispersed without formally expressing their thanks to those who have done so much for them, in a manner which could be recorded in the archives of the Institution. He thanked 'our friends from overseas,' the long list of area boards, companies and organizations to whom they were indebted, the authors of the papers ('we must not forget that without the papers it would be rather difficult to justify the meeting at all! '), the officers, the Council and Committees of the Institution, and finally, the Secretary and the staff of the Institution. 'When you see a team doing pretty well from year to year,' he added, 'you can be fairly certain that that team has a good captain, and so we extend a special word of thanks to Dr. Braunholtz for all he has done for us.'

The vote of thanks was seconded by Dr. A. Marsden.

Thus we came to the moment for the new President, Sir Henry Jones, to propose a vote of thanks to Mr. Hutchison, a task which he performed with his customary charm. We particularly liked his story of how the President had once prepared a paper for delivery to a certain body. A member of his staff,

An interested visitor at the Elliott Brothers (London), Ltd., works, the President adjusts a demonstration computor, watched by Mr. G. Fairbanks, the General Manager.

had commented, 'Very good, Sir, but don't you think it is perhaps a little above their heads? ' To which the President replied, 'If so it will teach them to look up.' Looking back on his year of office and on his address, said Sir Henry, some might say, 'Don't you think, Sir, that you are looking a little far ahead down the road into the future? ' If that were said, he might reply, 'Perhaps that will teach you to go a little faster.' Sir Henry spoke of the meeting as a 'glittering success'—an apt description indeed.

Seconding the vote of thanks, Mr. T. C. Finlayson said that in the present phase of our industrial development, it seemed to him that during his year of office the President of the Institution of Gas Engineers, by his choice of the subjects which were discussed in the June and Autumn meetings wielded a decisive influence on their technical thoughts and actions. In fact, during his year of office he might have been termed, rather, as Honorary Technical Director.

Sir Henry Jones then presented Mr. Hutchison with the certificate recording his Presidency during 1955-56 and the applause left no doubt concerning the distinction with which he had filled that position.

Memorable Visits

The weather had indeed cheered up and by the Wednesday, Institution weather had come to stay until the end of the meeting. The journey down the Thames by motor launch to the East Greenwich gasworks was delightful, the organization necessary to get the launch loads landed, assembled at the gasworks jetty, and introduced to their guides, being a masterpiece of what we might term spontaneous planning. The journey round the works was carried out to split second timing, but thanks to the tact of the guides this, too, might easily escape notice. Among the plant shown, which included the new coke oven batteries, what remains of the old horizontal retort houses, and the new solid fuel breeze fired boilers, was an interesting old gas engine designed and built in Kilmarnock in about 1870, with an unorthodox type of valve gear and flame ignition.

A visit to the Gothic Works of Glover and Main, Ltd., at Croydon, was no less enjoyable. Here again arrangements were admirable. This firm has expanded both their premises and potential output in the last few years, and conditions of work in light airy shops were noticeably good. Other visits took us to the Kensal Green works of the North Thames Gas Board, to see the East Surrey distribution system and Crawley New Town, to Brighton, to the most interesting Lewisham works of Elliott Brothers (London), Ltd., and to Mullard, Ltd. These, together with the ladies' visits, are described at length elsewhere in this issue.

So ended the 93rd A.G.M., one that will long be remembered with pleasure. It had the perfect recipe for success—an excellent venue, a very strong selection of papers including some which were noticeably 'progressive,' and, above all, a President commanding respect, possessed of both wit and wisdom, and, like all good captains, having an eye on the compass and a firm hand on the wheel.

THIS IS 'Gas Journal' SERVICE

This issue, published five days after the conclusion of the Institution Meeting, has been designed to present our readers with a complete picture of the event. Within these covers will be found:

1. **An eight-page illustrated review of proceedings.**

*

2. **Abstracts of ALL the papers.**

*

3. **Full reports of ALL discussions.**

*

4. **A special 16-page supplement on the visits.**

*

5. **A report of the I.G.E. Benevolent Fund.**

*

6. **Results of the S.B.G.I. Golf Meeting.**

*

7. **A host of candid camera studies by Stephen Tennant, A.R.P.S., our Staff Photographer.**

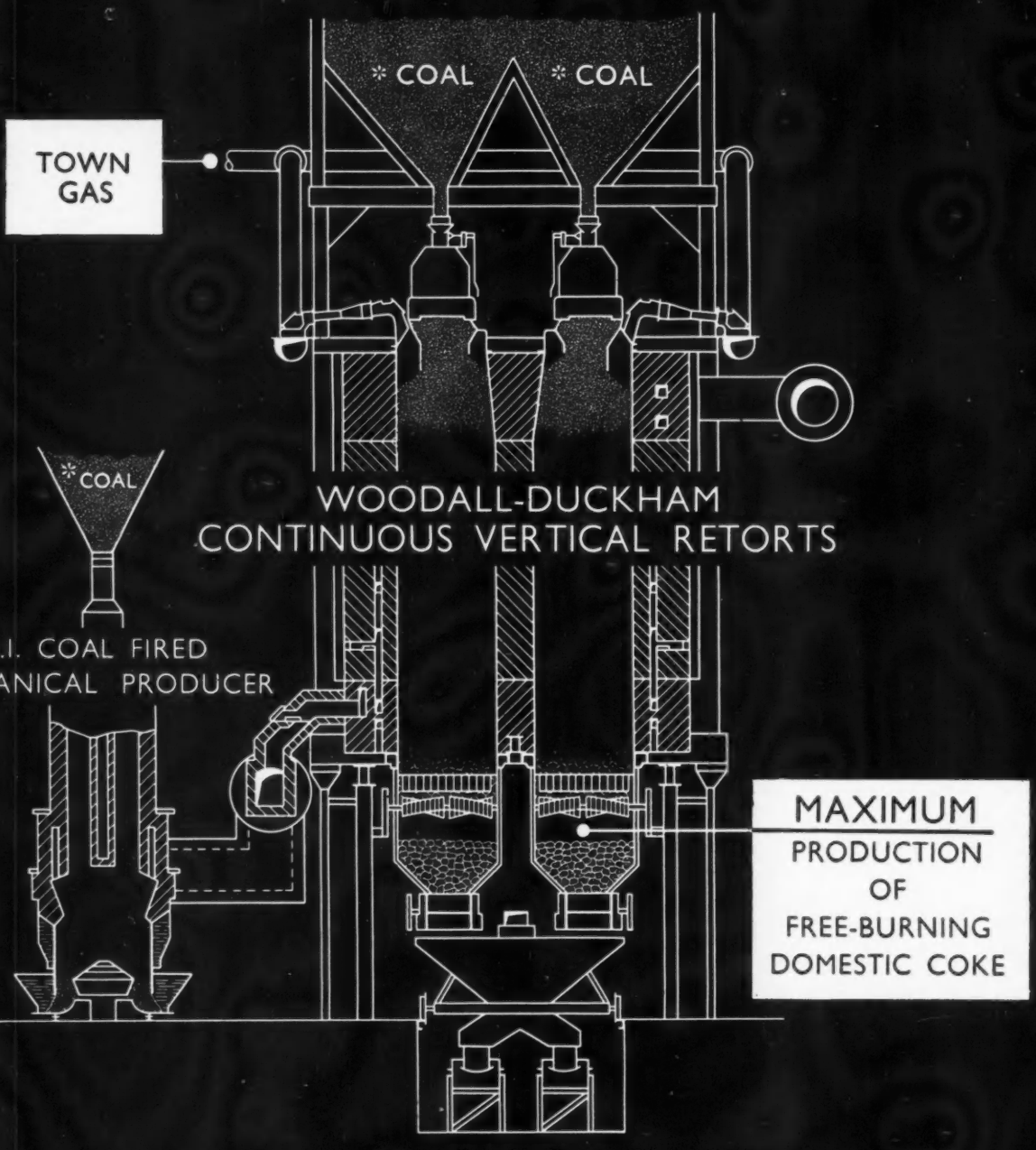
*

COMPLETE COVERAGE OF THE I.G.E. MEETING IN ONE ISSUE IS FOUND ONLY IN THE

'Gas Journal'

BLUE PRINT FOR TOMORROW

THE PRODUCTION OF FREE-BURNING SMOKELESS DOMESTIC FUELS FROM SIZED WEAKLY CAKING COALS *



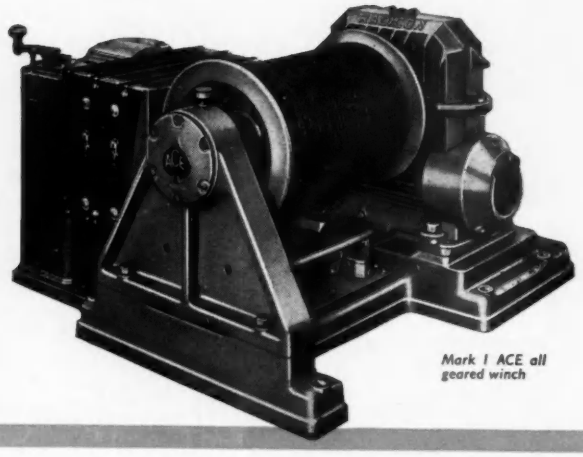
WOODALL-DUCKHAM CONSTRUCTION COMPANY LTD.

Woodall-Duckham House, 63-77 Brompton Road, London, S.W.3

Telephone: Kensington 6355 (10 lines). Telegrams: Retortical, (Southkens), London.

ACE
TRADE MARK

A WILLING WINCH FOR THE JOB . . .



Mark 1 ACE all geared winch

HEAVY DUTY STANDARDISED WINDING GEARS FOR ALL LIFTING, HAULAGE AND ERECTION

- Drum controller or push button.
- Capacities : ½ to 5 tons.
- Speeds can be arranged up to 300 ft./min.
- Strong rugged construction employing machine grooved rope drums and self-aligning ball bearings—a typical ACE job!
- State application when writing for details.

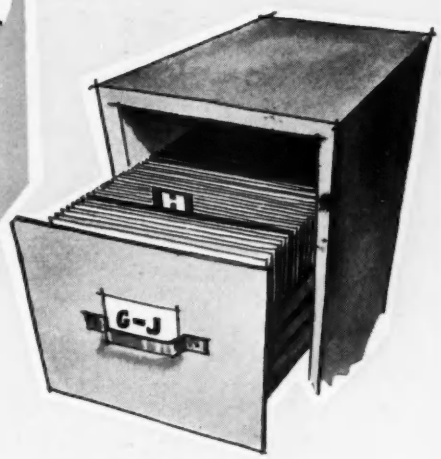
★ Mark 2 has the additional features of a hand operated clutch and foot brake for use when a free running rope drum is required for haulage and erection.

Mark 2 ACE all geared winch with rope drum clutch and foot brake

ACE
TRADE MARK
The Trade Mark of RELIABILITY

ACE MACHINERY LIMITED
HARLEQUIN AVENUE, GREAT WEST ROAD, MIDDLESEX
Telephone: EALing 4262 (5 lines) and at Brixton, London, S.W.2

H FOR HOLMES



If your requirements are for By-product Recovery and Ancillary Plant, you need look no further than the Holmes file.

If you do not have a set of our catalogues on your file, please let us know and this will be attended to immediately.

HOLMES HUDDERSFIELD

W. C. HOLMES & CO. LTD., TURNBRIDGE, HUDDERSFIELD

C 8226

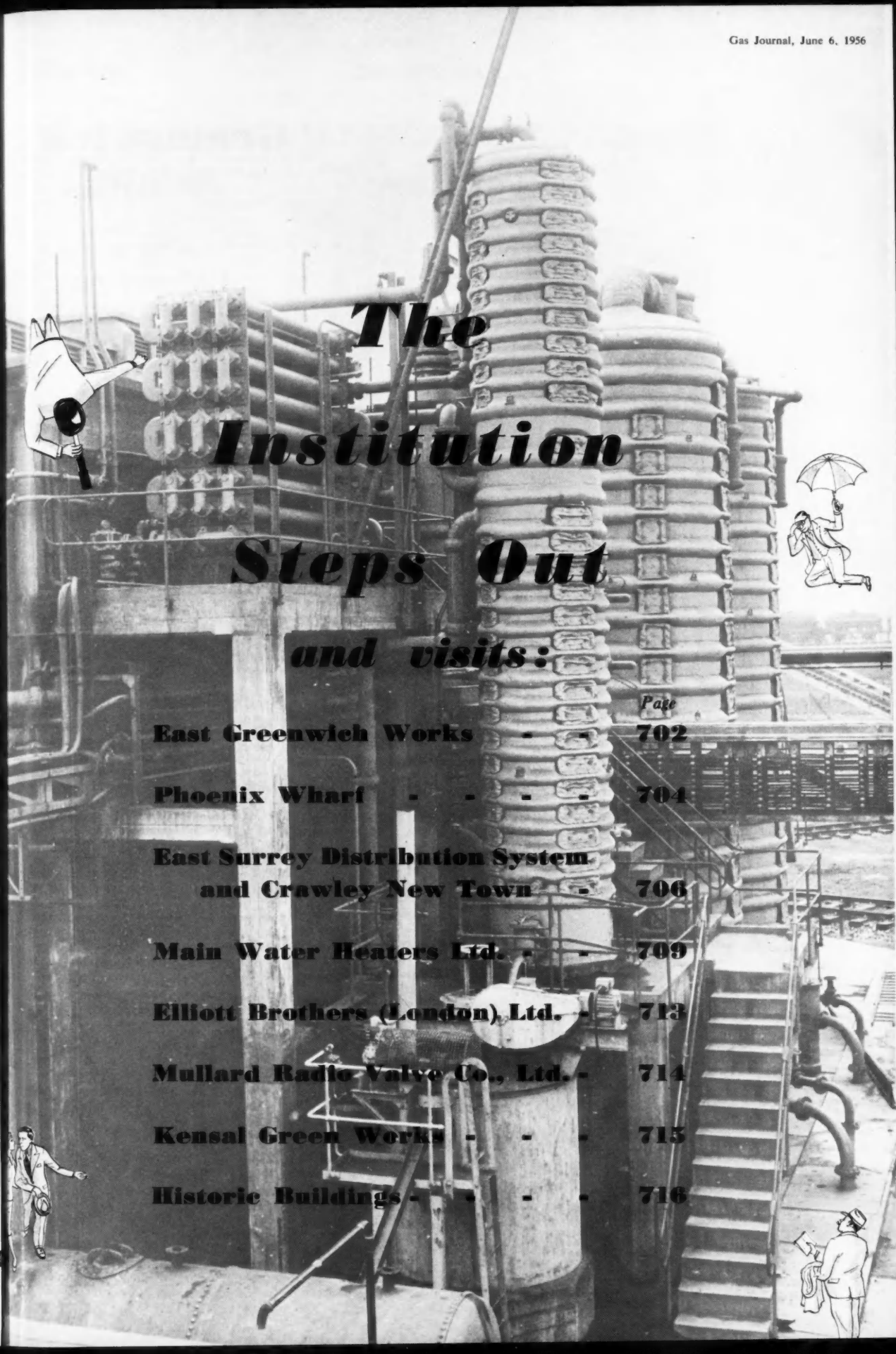
Tower Purifiers for the Gas & Coking Industry

These Tower Purifiers having a capacity of 26,000,000 cubic feet of gas per day were recently installed at the N.C.B. Coke Oven Plant, Avenue, Chesterfield.

Courtesy of the National Coal Board, East Midlands Division.

Newton Chambers

NEWTON, CHAMBERS & CO. LTD. THORNCLIFFE, Nr. SHEFFIELD



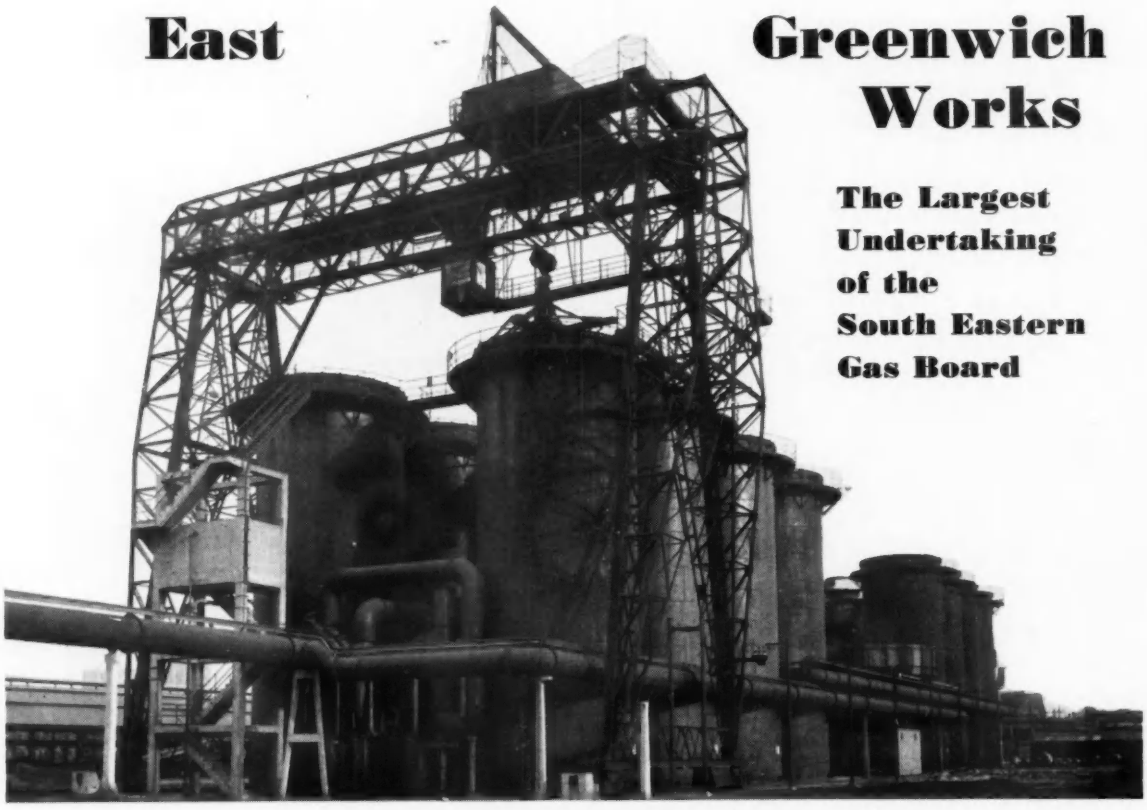
The Institution Steps Out

and visits:

	Page
East Greenwich Works	702
Phoenix Wharf	704
East Surrey Distribution System and Crawley New Town	706
Main Water Heaters Ltd.	709
Elliott Brothers (London) Ltd.	713
Mullard Radio Valve Co., Ltd.	714
Kensal Green Works	715
Historic Buildings	716

East Greenwich Works

The Largest Undertaking of the South Eastern Gas Board



Tower purifier installation.

EAST GREENWICH, the largest works of the South Eastern Gas Board, covers an area of 130 acres and has a river frontage, including the Board's chemical and tar works, of nearly one mile. The large 'T'-shaped jetty provides excellent facilities for the unloading of the Board's colliers, the discharging of coastal oil tankers, and the loading of coke into chartered vessels for export to the Scandinavian countries. There is also direct railway access to British Railways via the Board's extensive sidings at Angerstein. The maximum daily gas making capacity of the works is 72 mill. cu.ft. and this will be increased to 81 mill. cu.ft. by the winter of 1957-58 when a further C.W.G. plant at present under construction, together with the necessary ancillary plant, is scheduled to come into operation. The present layout is such as to permit the development of the works to a capacity of 102 mill. cu.ft. per day.

Fleet of Colliers

Most of the 1.2 mill. tons of coal unloaded at East Greenwich works annually is transported in colliers owned by the Board. The Board's fleet consists of 15 ships, the two largest of which carry cargoes of 4,000 tons and are suitable for discharge at East Greenwich only. Each year 360 ships are discharged at the jetty by four hydraulically-operated travelling cranes each equipped with 35 cwt. capacity grabs. The coal is unloaded into two sets of receiving hoppers, from which it is transferred, at a maximum rate of 500 tons per hour, by belt conveyors to the screening and crushing plant, situated inshore over a buffer hopper of 90 tons capacity, where a reduction to 2 in. in size is effected. From this hopper, coal can be despatched by rail to the retort houses or by conveyor to either the blending bunkers, which serve the coke oven plant, or to the outside stocking ground.

Oil Storage

Some 16,000 tons of oil are delivered to the works annually, in coastal tankers of up to 750 tons capacity, or in power barges berthed at the jetty. An alternative berth for barges is available at the wharfside, and facilities also exist for receiving oil by road or rail tank wagons. The four oil storage tanks have an aggregate capacity of 2,400 tons, and a further tank of 1,200 tons capacity is in course of construction. In the final arrangement, tank capacity will be allocated to the stocking of both gas oil and medium fuel oil (950 secs.) in the proportion of 2,000 tons and 1,600 tons respectively. In addition, tankage is planned for the receipt of bunker oil (3,000 secs.) for blending with the coal carbonized in both the coke ovens and horizontal retorts.

The conveyor system from the jetty transfers the coil either to the blending bunkers, of 7,200 tons capacity, or alternatively to the outside stocking ground, where there is accommodation for some 200,000 tons. The coal blending plant consists of six cylindrical bunkers, each of 1,200 tons capacity, where by regulation of the variable speed withdrawal belts reasonable blending can be effected before the coal passes forward to the hammer mills for final crushing. On the stocking ground, the coal scheduled for storage in the open, after being tipped off the overhead conveyor, is spread and compacted in 4 ft. layers by bulldozers, to a maximum depth of 25 ft. Surveys of coal temperature are carried out regularly. The recovery of coal to the coke ovens is by bulldozer discharging on to an underground conveyor, having a capacity of 300 tons/hour. The recovery of coal to the horizontal retort houses is by mechanical shovel and railway wagons, but the latter will be superseded by large tipping lorries in the future.

Gas-Producing Plant

Four batteries of Simon Carves twin flue compound ovens, heated by producer gas, carbonize a total of 2,000 tons of coal daily. The normal carbonizing period is 15 hours with a charge weight of 14.7 tons, giving a schedule of 127 ovens pushed and charged each day. The service bunker has a capacity of 3,000 tons. In order to ensure continuity of working, the two batteries of ovens, located on either side of the service bunker, are provided with their individual charging cars, ram machines, coke guides, locomotives and hot coke cars, permitting a system of operation with separate quenching stations, although the whole plant can be operated with one quenching tower if necessary.

The heating medium for the coke ovens is cold producer gas and fuel

economy is obtained by large regenerators, reversed automatically every 30 minutes, which preheat both producer gas and air for combustion while reducing the temperature of the chimney gases to 230°C. Provision has also been made for under-jet firing with coal gas if required. The dimensions of the ovens are: length overall 44 ft. 7½ in., height 2 ft. 6 in., width, ramside 1 ft. 3 in., pokeside 1 ft. 5½ in. Nos. 1 and 2 batteries are fitted with clay luted doors, but the more recently erected Nos. 3 and 4 batteries are fitted with the new 'Wolff' self-sealing doors.

Producer Gas

The producer gas installation comprises 12 'Marischka' mechanical producers, each capable of gasifying 25 tons of coke per day, with a nominal gas output of 4.25 mill. cu.ft.; their primary duty is the provision of lean gas for heating the coke ovens and this requirement can be met by nine producers, permitting the output of two further producers to be made available for the dilution of coal gas as required, with one producer in reserve. Each producer is equipped with a jacket boiler raising approximately 2,750 lb. per hr. of steam at 160 lb. per sq. in. and 550°F. The gas is cooled in scrubber towers, cleaned in electro-static precipitators and boosted in motor-driven boosters with a steam-driven standby; automatic controllers regulate the supply of gas to the ovens without the requirement for a relief holder.

The carburetted water gas installation consists of eight Humphrey & Glasgow fully automatic back-run carburetted water gas sets, with self-clinkering grates. The jacket boilers operate at 50 lb. per sq. in. and vertical waste heat boilers at 160 lb. per sq. in. Each set has a daily capacity of 3.26 mill. cu.ft. of carburetted water gas (500 B.Th.U. per cu.ft.). Two sets recently installed are of modified design to permit the carburetting of heavy oil (950 secs.). Adjacent machinery rooms house pumps, air blowers and gas boosters and all steam-driven units exhaust into the plant process steam main. The single lift column-guided relief holder has a capacity of 200,000 cu.ft. The plant is also equipped with detarrers, rotary naphthalene washers and Connersville meters. Coke is delivered to the overhead hoppers serving the generators direct from the coke oven coke screening plant by belt conveyors. Oil is stored adjacent to the plant in three tanks having a total capacity of 1,200 tons.

Horizontal Retorts

The horizontal retort installation consists of six benches, each of 15 settings of ten retorts, in two adjacent retort houses. The retorts are 20 ft. long with a 21 in. by 15 in. oval section. The retorts are charged and discharged by hydraulic machines and the settings are heated by built-in producers. Four of the benches are equipped with scrubber standpipes and Le Fleuve hot coke conveyors. The carbonizing period is 10 hours and the aggregate daily make of the 900 retorts is 16.2 mill. cu.ft. with a throughput of 1,460 tons of coal. Coal stores on either side of each retort house provide storage for some 11,000 tons. Each retort bench is equipped with a horizontal waste heat boiler raising, in total, 54,000 lb./hr. of steam at 160 lb./sq. in. and 530°F.

The gas from the coke oven batteries is treated in two streams of primary and secondary gas coolers, electro-detarrers and 12 bay static ammonia washers, each stream having a capacity of 15 mill. cu.ft. per day. Two Bryan Donkin turbo-exhausters, with a third as standby, are situated between the primary and secondary gas coolers; the exhaust steam from these machines is used to saturate the blast at the producer gas plant. The temperature of the gas leaving the primary gas coolers is automatically controlled and naphthalene is removed from the secondary gas coolers by regular flushing with a suitable blend of tar. Extension and alteration to this plant to enable it to handle the gas from six benches of horizontal retorts is in hand; when the scheme is complete, No. 1 exhauster house and four streams of gas condensers, Livesey washer and scrubber towers will be abandoned.

Purification Plant

The dry purification plant consists of two streams of tower purifiers, each having a maximum daily capacity of 16 mill. cu.ft., two streams of dry lute boxes, and four streams of wet lute boxes. All streams operate on the backward rotation system and together have an aggregate capacity daily of 72 mill. cu.ft. A further stream of tower purifiers of similar capacity to the existing towers will be brought into commission by the winter of 1957-58.

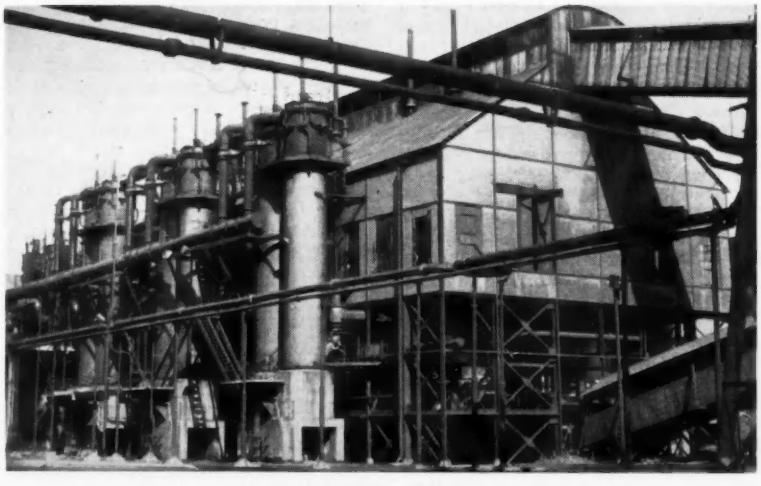
Benzole and naphthalene are removed from the coal gas by a recovery plant, with a nominal daily capacity of 33 mill. cu.ft., equipped with vacuum type stills. The stripped gas is diluted with water gas or producer gas as required through an automatic calorific value controller on the outlet side of the benzole plant and immediately on the inlet of the pressure-relieving boosters.

Twelve wet drum type meters, having an aggregate daily capacity of 50 mill. cu.ft., and two Connersville meters, each with a daily capacity of 15 mill. cu.ft., register the make of the station. The two gasholders are of the guide-framed type, and have an aggregate capacity of 17.5 mill. cu.ft. No. 2 holder was originally constructed in 1892, with a capacity of 12 mill. cu.ft. and with six lifts, two of the flying type which extended above the guide framing when the holder was fully inflated. The holder was damaged in the Silvertown explosion in 1917 and subsequently the two outer lifts were removed.

Preparation and Loading of Coke

The coke made in the horizontal retort houses and the coke ovens is treated in separate plants, served by belt conveyor systems direct from the production points before being transferred to the coke sales hoppers, having a capacity of 4,200 tons, or to ground storage. The horizontal retort plant has a capacity of 80 tons an hour, and the coke oven plant a capacity of 100 tons an hour. Both plants are fully equipped for grading the coke into standard sizes and for breeze separation. Facilities are provided for the loading and despatch of coke from the sales hoppers for transport by ship, barge, road or rail, while mobile debreezing units of 100 tons an hour capacity with ancillary equipment permit rapid recovery from ground stock for any purpose. Mechanical shovels with large capacity buckets have been developed for general coke-handling duties.

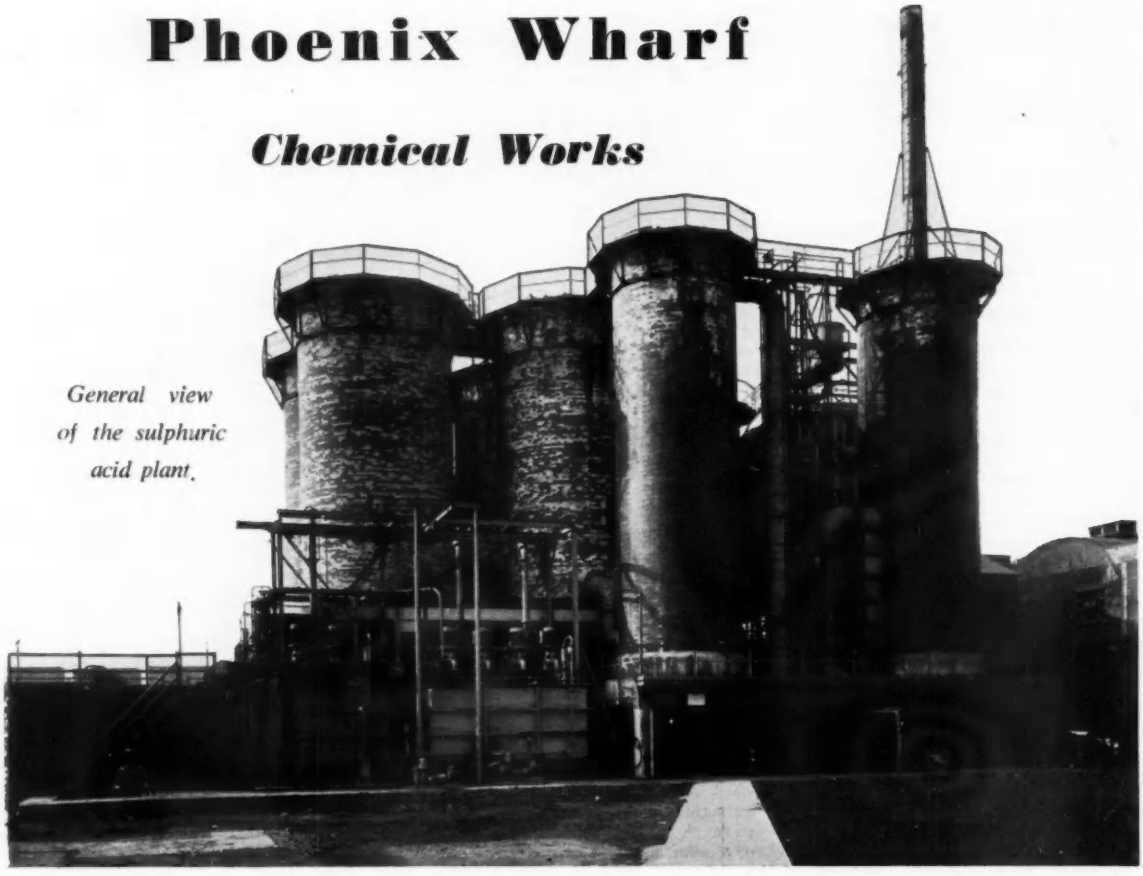
In addition to the waste heat boilers associated with individual plants there is an installation of water-tube boilers. These are normally fired by coke breeze, but provision has been made for future conversion to liquid fuel firing if required. There are three boilers, Babcock and Wilcox type C.T.M., each equipped with chain grate stoker, forced and induced draught fans, recirculating fan for control of ignition of breeze, economizer and grit arrester. The boilers have an evaporative capacity of 25,000 lb. an hour each at 160 lb. per sq. in. and 550°F., with a peak capacity of 30,000 lb. an hour for a period of two hours. The boiler auxiliaries include a de-aerator and turbo-feed pumps.



Producer gas plant.

Phoenix Wharf

Chemical Works



General view of the sulphuric acid plant.

THE South Eastern Gas Board's chemical products department is responsible for the processing and sale of all the by-products of gas manufacture (except coke) in the area served by the Board. Situated at Phœnix Wharf, the chemical works adjoins the East Greenwich gasworks, and the main products are sulphuric acid and sulphate of ammonia. About 75% of the sulphuric acid produced is used in the production of sulphate of ammonia. The remainder (about 12,000 tons) is sold under contract,

Demand Exceeds Supply

All the ammoniacal liquor from the Board's own gasworks, together with supplies obtained from works controlled by other area boards, is used at Phœnix Wharf to make 'Metro' sulphate, which has been recognized for over 30 years as a fertilizer of superlatively high quality. Its sale is limited only by the amount that can be produced. 'Metro' sulphate is sold for direct application to the soil to farmers in the South and East of England, from Lincolnshire in the North to Salisbury in the West.

Phœnix Wharf—the site of a chemical works since 1869—suffered seriously during the war, both as a result of enemy action and of difficulties in keeping up the normal repairs and maintenance programme. It was realized that complete renewal of certain plant, as well as extensive repairs to buildings and attention to foundations, drains and roads, would be necessary to restore the works to a satisfactory state of repair. Apart from an eventual reduction of repairs and maintenance costs, this procedure could not have materially reduced production costs.

As an alternative, new plant could be designed and erected on a new and convenient existing site. By this means, advantage could be taken of modern plant design, of new constructional materials, and of process control. It would be possible to reduce repairs and maintenance costs and, at the same time, to increase productivity considerably. Another important consideration in such a reconstruction scheme was the opportunity to improve working conditions for personnel.

A plan was therefore prepared for the erection of a new sulphuric acid plant, for modifications to part of the existing sulphuric acid plant, and for the erection of new plant for the production, storage and despatch of 'Metro' sulphate of ammonia. This project was adopted by the Board in 1949. Site clearance began in 1951 and the new plants were ready for operation in 1955.

Production Capacity

The reconstructed works is capable of manufacturing annually 44,000 tons of 77% sulphuric acid from spent oxide from the Board's area, and 30,000 tons of sulphate of ammonia from gas liquor produced in the metropolitan divisions of the Board and from concentrated gas liquor from outlying works in the Board's area and from gasworks of neighbouring boards. Up to 20,000 tons a year of gas purifying material can also be produced, using the iron oxide left after the burning of spent oxide in the sulphuric acid plant.

Motorized Plant

All the mechanical plant, including pumps, fans, etc., is completely motorized and the maximum consumption of electricity, which is supplied by the East Greenwich gasworks' turbo-generators, is 500 kW an hour. Approximately 18,000 lb. of low pressure steam an hour for process purposes and approximately 3,000 lb. of steam an hour at 100 lb. p.s.i.g. are also used. River water for cooling purposes is also taken from the gasworks river water circulation system and amounts to approximately 40,000 gal. an hour.

All the buildings, and other civil engineering work, were designed by the Board's central construction department and the plant and ancillary equipment was designed by the works technical staff in collaboration with the main contractors.

The new 'Metro' sulphate of ammonia plant consists of two similar units (housed in concrete-framed, brick-panelled buildings), each of which can

produce 65 tons of 'Metro' sulphate a day. The stills, which are of cast-iron construction with mild steel bubbling hoods, are each 8 ft. diameter by 33 ft. high. Each still has been designed to deal with approximately 5,000 gal. an hour of liquor containing 3% of ammonia.

The steam used for distillation is low pressure steam 20 p.s.i.g, which is supplied to the works from pass-out turbines in the generator house at the adjacent gasworks. The liquor used is a mixture of crude gas liquor and concentrated gas liquor, each of which is stored in separate concrete tanks and separately pumped to the stills through appropriate meters. The crude gas liquor is first passed through coke filters to remove all traces of tar. Before entering the stills the two streams of liquor are blended into a feed of pre-determined strength. Spare pumps and meters for both streams are installed to ensure continuity of operation. Hot waste gases from the saturators are used to preheat the feed liquor by passage through heat exchangers of orthodox multi-tubular design. Additional coolers of similar design are provided so that the gases can be cooled sufficiently for subsequent disposal to the sulphuric acid plant. The stills, gas coolers and tar filters are outside the plant building.

Saturators

Each saturator is of mild steel plate construction lined both with chemical lead and with tongued and grooved acid-resisting tiles. The saturators are provided with conventional type salt ejectors which discharge the magma of crystals and mother liquor into conical shaped thickeners, designed to increase the proportion of crystals in the magma to 60-70%. The surplus mother liquor flows by gravity back to the saturator by way of a funnel-shaped charge pot, where it is mixed continuously with a measured quantity of sulphuric acid of appropriate strength.

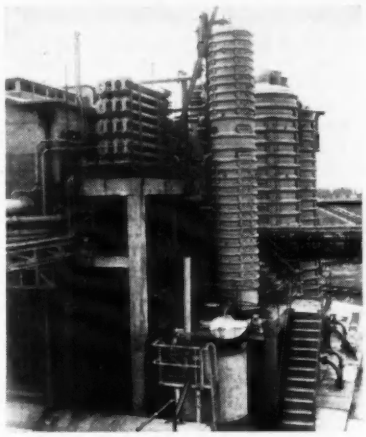
The thickened magma of crystals is discharged continuously to automatic centrifuges of the pusher-plate type, constructed in a special alloy steel. Each of these machines has a capacity of approximately 3 tons of ammonium sulphate an hour and reduces the moisture content to about 1%. The mother liquor from the centrifuge is pumped continuously to the charge pot of the saturator and the crystals are taken on a belt conveyor to dryers of the Royston 'flash' type. Here the salt is elevated by heated air and allowed to fall in a cataract tube against a rising current of hot air.

The dried crystals pass out through a motorized valve to a venturi tube, which forms part of a pneumatic elevator conveying the salt to the store. This elevator discharges into a cyclone separator from which the salt is deposited on to a steel band conveyor running the length of the store building.

The new store is the largest for sulphate of ammonia in the South of England, and its design and construction are of special interest. The design is purely functional—the store being shaped to cover a heap of 10,000 tons of sulphate. Its structure is of approximately parabolic cross section, and consists of reinforced concrete retaining walls carrying precast and prestressed concrete arches. It is covered with precast and prestressed concrete slabs and it is finished externally with bituminous fabric. It is about 170 ft. long, 96 ft. wide and 66 ft. high. The packing and loading house, which is built on to the end of the main store, is about the same width and has a length of 60 ft.

In the apex of the store building is suspended the steel band conveyor from which the salt can either be deposited on the floor of the store or delivered directly (over the conveyor terminal) through screens into a 40-ton hopper in the packing house. Stored salt is recovered by drag scraper to the boot of a bucket elevator which delivers it through the screens into the hopper.

From the hopper, the salt is discharged into two automatic weighing machines which have sack-filling spouts. Containers, both paper sacks and hessian bags, are fed along a transverse conveyor on which they are filled with the pre-weighed quantity, and then closed and sewn. From the transverse conveyor the containers are diverted on to steel band loading-out conveyors, which can deliver to a loading bay for rail wagons or alternatively to a loading bay for road vehicles. The capacity of the reclaiming packing and loading machinery is about 50 tons an hour.



Liquor ammonia plant and stills.

Attached to the sulphate of ammonia plant is a plant for the production of semi-pure ammonia solution of approximately 25% strength. This product is required for conversion to nitric acid in the ammonia oxidation units connected with the sulphuric acid plant.

The new sulphuric acid plant is the first of its type in this country and possesses many unique features. It uses the Kachkaroff process, an intensive tower process which was developed in Europe in the late 1930s. It was chosen because of its ease of control, economy of working and comparatively low repair and maintenance costs. The plant at Phœnix Wharf will produce 65 tons of 77% sulphuric acid a day, using spent oxide as a raw material.

Basically, the plant consists of mechanical furnaces for the combustion of the sulphur in spent oxide to sulphur dioxide and a series of packed masonry towers in which the sulphur dioxide is converted to sulphuric acid. Spent oxide, which comes into the works by rail, road, and river transport, is crushed and screened to provide a feed of uniform size for four Harris mechanical spent oxide furnaces. A mechanical loading shovel takes the material from the crushing plant to the burners.

Each spent oxide furnace will burn about 10 tons of spent oxide a day. The furnaces are housed in a concrete-framed brick-panelled building of similar design to the sulphate of ammonia plant building. In this building also is a brick chamber which acts as a connecting flue and in which most of the dust carried over with the combustion gases is deposited. The combustion gases contain about 8% of sulphur dioxide and leave the flue at a temperature of 600°C. They then pass into the base of a 'concentrating tower' 16 ft. diameter, 36 ft. high, constructed in acid-resisting brickwork (sheathed in lead and filled with ring packing). They ascend this tower against a counter current flow of weak sulphuric acid. The gases are thereby cooled to approximately 150°C. and the weak sulphuric acid is concentrated to a strength of 77%.

Storage Tanks

All the sulphuric acid produced in the plant passes through this tower and is delivered to the two storage tanks as acid of not less than 77%. Each tank is of welded mild steel construction, 22 ft. diameter, 16 ft. high, with a total capacity of 500 tons.

The cooled gases then pass into a 'denitrating tower' and thence through four 'reaction towers' in series constructed of acid-resisting brick with acid-resisting ring packing. They are 22 ft. diameter, 36 ft. high. Through these towers, 80% sulphuric acid containing approximately 10% N_2O_3 is circulated at the rate of 75,000 gal. an hour, and it is here that the main reaction takes place, the sulphur dioxide being converted into sulphuric acid.

A fixed quantity of the sulphuric acid is bled from the 'reaction tower' circulation system continuously and fed to the 'denitrating tower' in which, by dilution with water and contact with the warm gases leaving the 'concentrating tower,' the oxides of nitrogen are removed. The acid leaving the 'denitrating tower' forms the weak acid fed to the 'concentrating tower.' On leaving the 'reaction towers' the gases are passed through two smaller towers of similar design and construction, in which acid mist is removed. Any oxides of nitrogen leaving the 'reaction towers' are absorbed in 77% sulphuric acid. Between these towers is a fan which propels the gases through the system and produces the necessary draught for the spent oxide furnaces.

A large proportion of the original lead chamber acid plant is being retained and modernized. Harris mechanical furnaces replace the existing hand-fired oxide kilns.

Crawley New Town

GASHOLDER AND BOOSTER STATION

THE new town of Crawley is being developed as a balanced and self-contained community to decentralize industry, commerce and population from crowded London. Homes, factories, offices, schools, playing fields and churches are being developed side by side so that inhabitants of Crawley can live happy, productive, and efficient lives without the waste of time and burden of travel. The population of about 9,000 in 1947 has now reached 29,500 and is expected to increase by 5,000 annually until it reaches 50,000 to 60,000.

Trunk Mains

The South Eastern Gas Board decided that to meet the very considerable gas requirements of Crawley new town and the districts served by the former East Surrey and Horley Gas companies, it would be necessary to lay a 24-in. main from Waddon works at Croydon to the holder station at Hooley Lane, Redhill, continuing with an 18-in. main to a holder site at Crawley where the gas will be delivered into a 1½ mill. cu.ft holder. The supply to the new town is given by a ring main laid around the town, and the various neighbourhoods are supplied through district governors. This main is 20-in. in diameter at the outlet of the holder station, gradually reducing to 12-in. diameter at the southern side of the town. Gas flow into and out of holder stations is recorded by ring balance flow meters.

The No. 1 trunk main section—Waddon works, Croydon, to Hooley Lane holder station—consists of approximately 12 miles of 24-in. main which was laid in 16-ft. lengths of pipe, supplied by the Staveley Iron and Chemical Company. The mainlaying contract was carried out by William Press and Son, Ltd., and completed in approximately 20 months. The whole of the pipes and special castings were delivered to the site by road transport.

Trunk main crossing a stream near Horley.

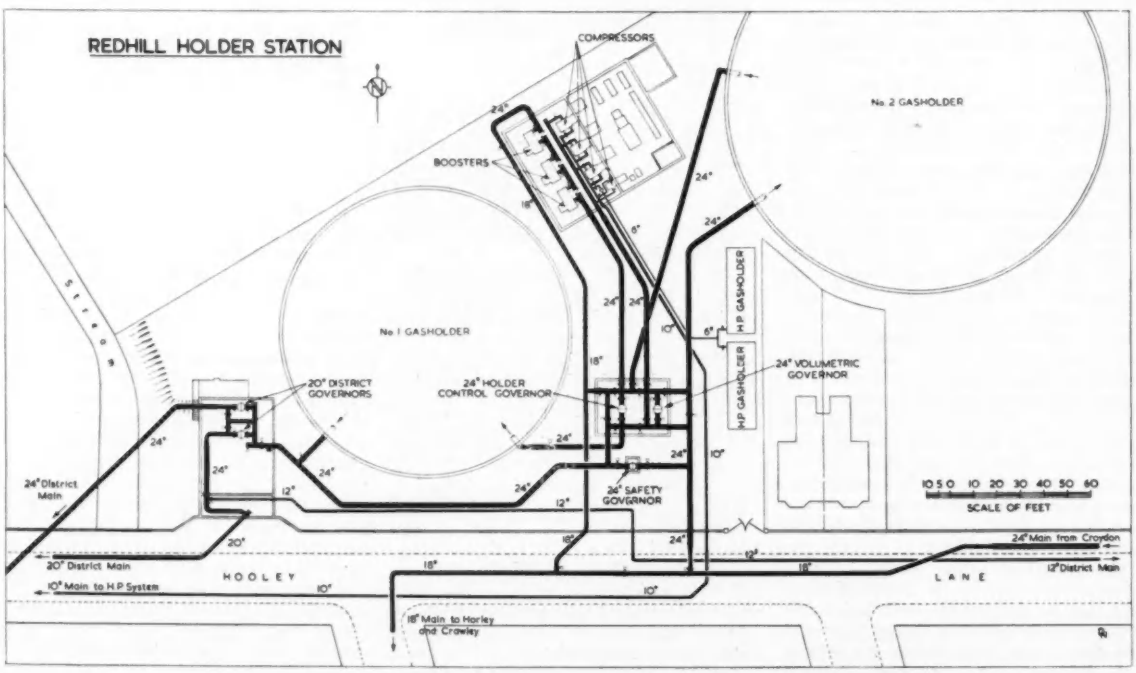
Three branches have been taken off this main to underground Peebles governors fitted with clock mechanism to vary automatically the pressures on the outlet of the governors to meet the demand of the districts supplied by them. A 12-in. dia. branch is also taken off at Hooley for a bulk supply to the West Surrey Division at Kingswood. In addition to the normal negotiations with local authorities and other public utility authorities it was necessary to make special arrangements with the British Transport Commission for laying the main under six railway bridges and to make agreements with three owners of land for the main to be laid through their property.

The No. 2 section—Hooley Lane holder station, Redhill, to Horley works—consists of approximately 4½ miles of 18-in. main which was laid with the same type of pipes as the previous section. The laying of this part of the main was begun in September, 1949, and completed in July, 1950. The mainlaying contract was carried out by G. S. Faulkner and Sons, Reigate. Agreements were made with six owners of land for the main to be laid through their property and with the British Railway Commission for laying the main under two railway bridges.

Dense Woodland

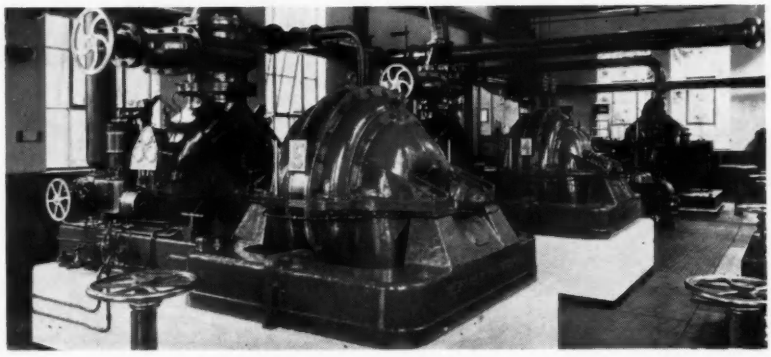
The No. 3 section—Horley works to Crawley holder station—consists of approximately 3.6 miles of 18-in. main which was laid in 18-ft. lengths supplied by the Stanton Ironworks Company. Mainlaying was carried out by William Press and Son Ltd., and was begun in April, 1951, and completed in October, 1951, and is now extended to the inlet of holder. Agreements have been made with five owners of land for the main to be laid through their property. Part of this section has been laid through dense woodland and it was necessary to clear the undergrowth, fell trees and blow up their roots before the pipes could be placed in position.

A 20-in. dia. main in 18-ft. lengths has



been laid from the outlet of the Crawley holder and continued in 18-in. and 14-in. dia. main to serve the completed neighbourhoods. Approximately 4.6 miles of this main has been laid, and will be extended in conjunction with developments of neighbourhoods now in course of construction. Governors have been installed to supply West Green, Northgate, Three Bridges, Pound Hill, and Southgate residential areas, and the industrial area.

The No. 1 section between Waddon works, Croydon, and Redhill gas holders and booster station also supplies a number of districts en route—Kingswood and the West Surrey Division at Tadworth, Hooley and Chipstead, Merstham and the L.C.C. estate, Bletchingley and Nutfield.



Turbo boosters at Waddon Works, Croydon.

Redhill

Redhill works is closed as a manufacturing station, and the gasholder station, situated some half mile or so from the works, is being developed into a major distribution centre to meet the demands not only of Crawley new town but the general requirements of the south western half of the Division, gas being distributed at high, medium, and low pressure according to the district. There are two gasholders at this station, one of 2 mill. cu.ft. and one of 1 mill. cu.ft. capacity.

New Gasholder

At the present time, the boosters at Waddon works, mentioned earlier, are able to pass all the gas required at Redhill, Reigate, Horley and Crawley, a distance of approximately 25 miles, including the supply to the ring main at the new town. When the installation is complete, Waddon gas will be received into the Redhill gasholders and will then be re-pumped to the new gasholder station at Crawley, supplying the Horley holder en route. The machinery installed for this purpose comprises:—Three 250,000 cu.ft. per hour Bryan Donkin boosters driven by A.C. flame proof L.D. motors, delivering gas at 50-in. pressure when working singly, or any two machines can work together in series to deliver gas at an initial pressure of 100-in. water gauge.

New Machinery

In the same building as the Crawley boosters, new electrically driven compressors are installed to supply gas under high pressure to the East Surrey District, including Dorking, Reigate holder station, and neighbouring hamlets. This new machinery supersedes the steam and electrically driven compressors at the old Redhill works. The mileage of high pressure main involved is 76 and pumping is, of course, continuous, day and night, throughout every day of every year.

The machines installed for this duty are three 75,000 cu.ft. per hour Bryan Donkin vertical reciprocating compressors driven by L.D., D.C. motors. Any two machines working in parallel will deliver 150,000 cu.ft. of gas per hour at an initial pressure of 25 lb. per sq. in., and under light load conditions, one machine only will be required, delivering half this quantity. Electricity for these motors is taken from the local electricity supply via transformers and mercury arc rectifiers.

Although this station is reasonably well covered by the Electricity Authority by alternate feeds, it has been considered desirable to include a diesel driven generator as a standby, and a 350 K.W. Blackstone diesel driven alternator forms a part of the installation. This machine, which is of 540 horse power, running at 750 r.p.m., is also equipped with an automatic starting device, in the event of a failure of the local electricity supply.

Further Safeguard

As a further safeguard against the failure of the auto-starter and to cover the time taken to change over the main switchboard to the alternator supply, two high pressure gasholders have been installed, each 12 ft. in diameter by 37 ft. long, having a capacity volume of approximately 3,750 cu.ft. each. The releasable capacity of each vessel will be 20,000 cu.ft. per hour of free gas, between the working pressure of 100 lb. per sq. in. and 20 lb. per sq. in.

This volume will allow approximately 20 minutes at periods of peak demand for starting the alternator manually, following the change-over to the alternator bus bars, the gas being automatically released when the pressure in the high pressure main falls below a predetermined limit.

Two new 20-in. Peebles automatic pressure-operated station governors have been installed in an existing building, to govern the gas supply in the town of Redhill and the immediate neighbourhood. There is also a central valve area, external to the main building, where all movements of gas into and out of the station will be controlled

The supply to Redhill and district is safeguarded by the installation of a Bryan Donkin safety governor. A gas-ignited forced draught oil-fired anti-freeze boiler forms part of the equipment of this station.

Four miles south of Redhill on a site adjacent to the former manufacturing station is installed a new 1½ mill. cu.ft. Robert Dempster gasholder (designed for 2 mill. cu.ft.) and supplied from the Crawley main, through an 18-in. Bryan Donkin volumetric governor. In the governor house itself are two 14-in. automatic pressure-operated station governors supplying the local distribution system.

It is from this station that Horsham, in the Sussex Division, receives its supplies in bulk, and the machines installed for this purpose are two 30,000 cu.ft. per hour Reavell rolling drum type compressors, delivering gas at an initial pressure of 12 lb. per sq. in. and driven by L.D., A.C. flame proof motors.

As a standby to these machines, and as a precaution against the failure of the public electricity supply, one 50,000 cu.ft. per hour Reavell rolling drum type compressor, driven by a Ruston and Hornsby vertical diesel engine, has been installed. The anti-freeze boiler at this station is coke fired, but its adaptation to oil firing is under consideration. The registration of gas delivered to Horsham is by Connesville meter installed in the compressor house at Horley.

Crawley

In a five-acre field, away from the houses and factories of this new town and in the heart of picturesque woodlands, a new 1½ mill. cu.ft. Robert Dempster gasholder is under construction (the holder has been designed for an eventual 2 mill. cu.ft. capacity), and adjacent to this holder is the booster house containing three 500,000 cu.ft. per hour Donkin, Rateau turbo boosters driven by Ruston and Hornsby vertical diesel engines, which will supply the ring main of the new town.

The connections to this plant are arranged so that each booster can be operated singly to deliver gas at an initial pressure of 30-in. water gauge, or any two can work together in series to deliver gas at an initial pressure of 60-in. water gauge. Diesel engines were chosen for this duty owing to the non-availability of an electricity supply in the reasonably foreseeable future.

The first of the two gasholders planned will be in an advanced stage of construction by May 30, 1956. The second holder will be built at a later date, when the full potentialities of the new town can be gauged. An oil-fired anti-freeze boiler forms part of this installation similar to that installed at Redhill.

like the Century cooker...

it looks even better

in Colour!

The popular Century Cooker is now the colourful Century . . . it's available in cream and blue, in cream and green, or in all cream finishes. The two colour models have the hotplate, platerack, tap knobs and oven door handle in the green or blue finish. On all models the oven tap knob is red.

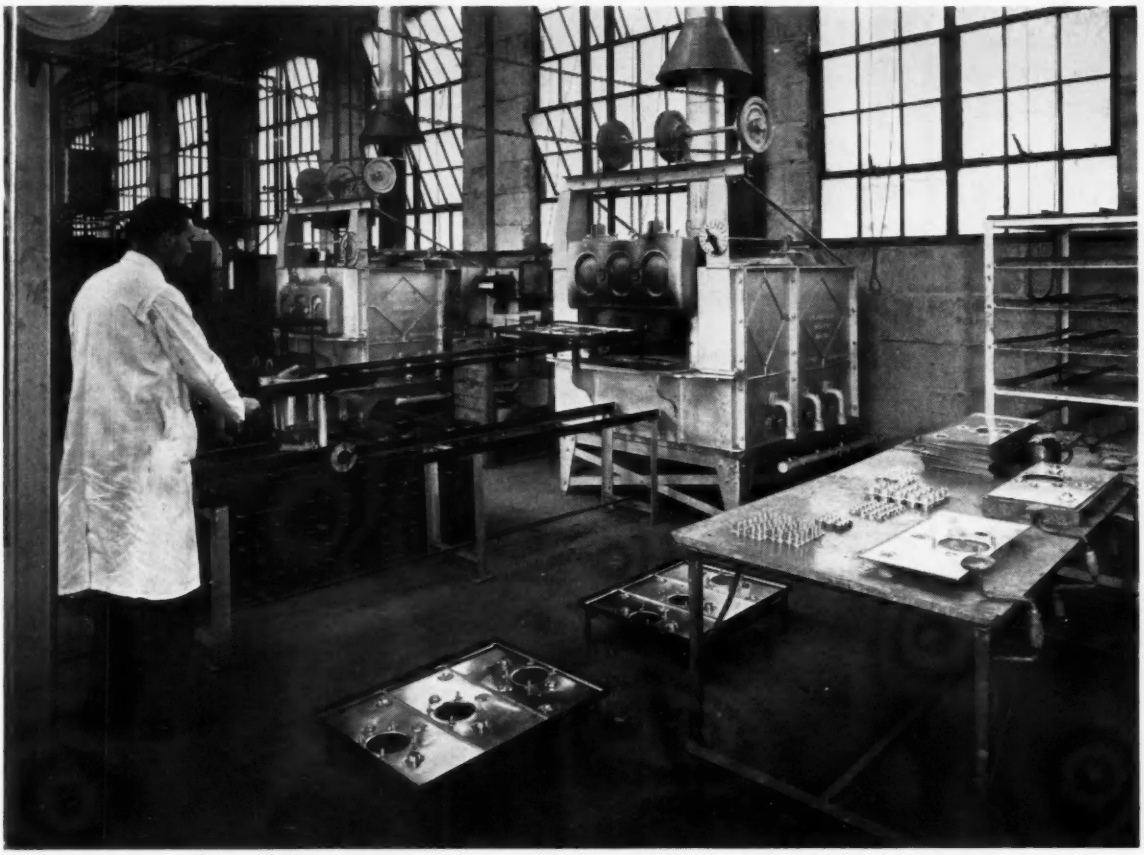
The Main
CENTURY
Cooker

R. & A. MAIN LIMITED LONDON and FALKIRK

Note the name-made by MAIN

C113

Main Water Heaters Ltd.



Furnace soldering of Thermain No. 15 water heater chamber bases to ensure complete soundness of joints between sheet metal base and attached gas and water connections.

ALTHOUGH members of the Institution have visited the Glover & Main factories at Gothic Works, Edmonton, on two previous occasions, this was their first visit to the Croydon Works of Main Water Heaters Ltd. This works has recently been considerably extended and, with the installation of new and up-to-date plant, is now one of the most modern factories in the Glover & Main group. The buildings are completely insulated and are heated by the latest type of overhead panel heaters which are controlled automatically, according to the temperature outside the building, thus ensuring even and pleasant working conditions in the workshops.

Carefully Planned

The route through the factory was carefully planned to offer the maximum interest to the visitors during the limited time at their disposal. Passing first through the polishing shop where they were shown the method by which, using high-speed mops and wheels, skilled operators impart the necessary high polish to non-ferrous components prior to chromium plating, the visitors entered the sheet copper shop and after a brief description by their guides of the general nature of the work carried out in the shop, proceeded to the gravity and pressure testing section.

Process Described

Here a technician described the testing operation in progress: The air pressure testing of Thermain No. 2 and New Junior boilers and Minimain heat exchangers using air pressures ranging from $2\frac{1}{2}$ to 30 lb. per sq. in., and the 24-hour gravity test on New Junior bodies and boiler and the Thermain No. 15.

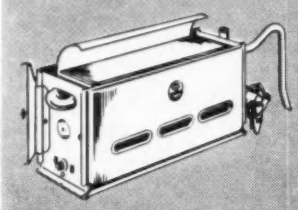
Continuing, the visitors were shown the group piercing of the New Junior (A/V) base in the fly-press section, the brazing and soft soldering of water-ways, etc., by skilled craftsmen using high-pressure gas irons and brazing torches, and the brazing of copper heat exchangers in the bright brazing plant. On this plant the exchangers pass through the furnace on a conveyor belt and, being brazed in an inert atmosphere generated from town gas by the gas plant, remain bright and untarnished.

Adjacent to the bright brazing furnace the visitors watched as a technician demonstrated and explained the assembly and furnace soldering of water heater chamber bases for the Thermain No. 15 and Thermain No. 2 storage water heaters, a technique that ensures complete soundness of the joints between the sheet metal base and its attached gas and water connections. Finally in this shop they were shown the assembly of heat exchanger units for instantaneous type water heaters and the cutting and bending of tubes for the Minimain and Thermain No. 15.

Sheet Iron Department

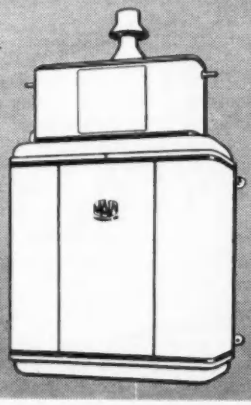
Commencing the tour of the sheet iron department, the guides again first gave a preliminary outline of the work carried out as a whole, before proceeding through the sheet metal shop, the press shop, the oxy-acetylene welding shop and the arc welding shop, which comprise this department. Here the series of operations in the fabrication of com-

instantaneous
for the bath . . .
the New Junior



instantaneous
for the kitchen
sink . . .
the Minimain

storage for the
sink or wash basin
. . . the Thermain No.2



storage for a
complete
household
service . . .
the Thermain No.15

there is a
MAIN
water
heater
for every
domestic
purpose

Note the name - made by MAIN

W65

MAIN WATER HEATERS LTD., GOTHIC WORKS, THORNTON ROAD, CROYDON

ponents in non-ferrous material ranging from 22 s.w.g. to 16 s.w.g. were demonstrated and explained in detail by the attendant technicians.

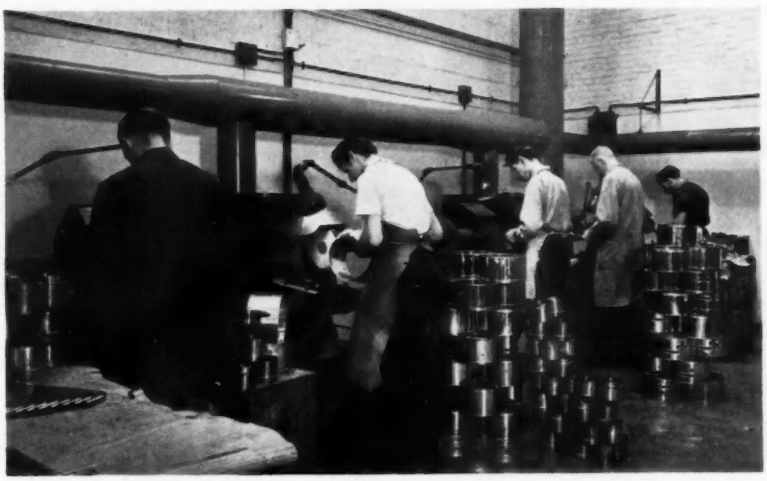
Leaving the sheet iron department the tour continued via the bonderizing shop to the paint shop. This, one of several departments recently modernized, is now equipped with the most up-to-date plant including a gas fired continuous camel back conveyor oven in which components with a paint finish are stoved after spraying, and the latest type of waterback spray booths. From the paint shop the visitors proceeded to the electroplating and pickle shops, also recently modernized. Here they were shown how articles for plating are first 'pickled' in acid, then scoured and cleaned in an electrolytic cleaner, and finally electrotinned in the plating vats.

Assembly Shop

After passing through the sheet and dip tinning departments the tour was completed in the assembly shop. This department held a multiplicity of interest for the visitors for here they were able to watch the final assembly of the various types of water heaters from the components they had seen in course of production during the early part of their tour, the calibration of thermostats, the lagging of storage type heaters, and the stringent tests to which every heater is subjected before being finally passed.

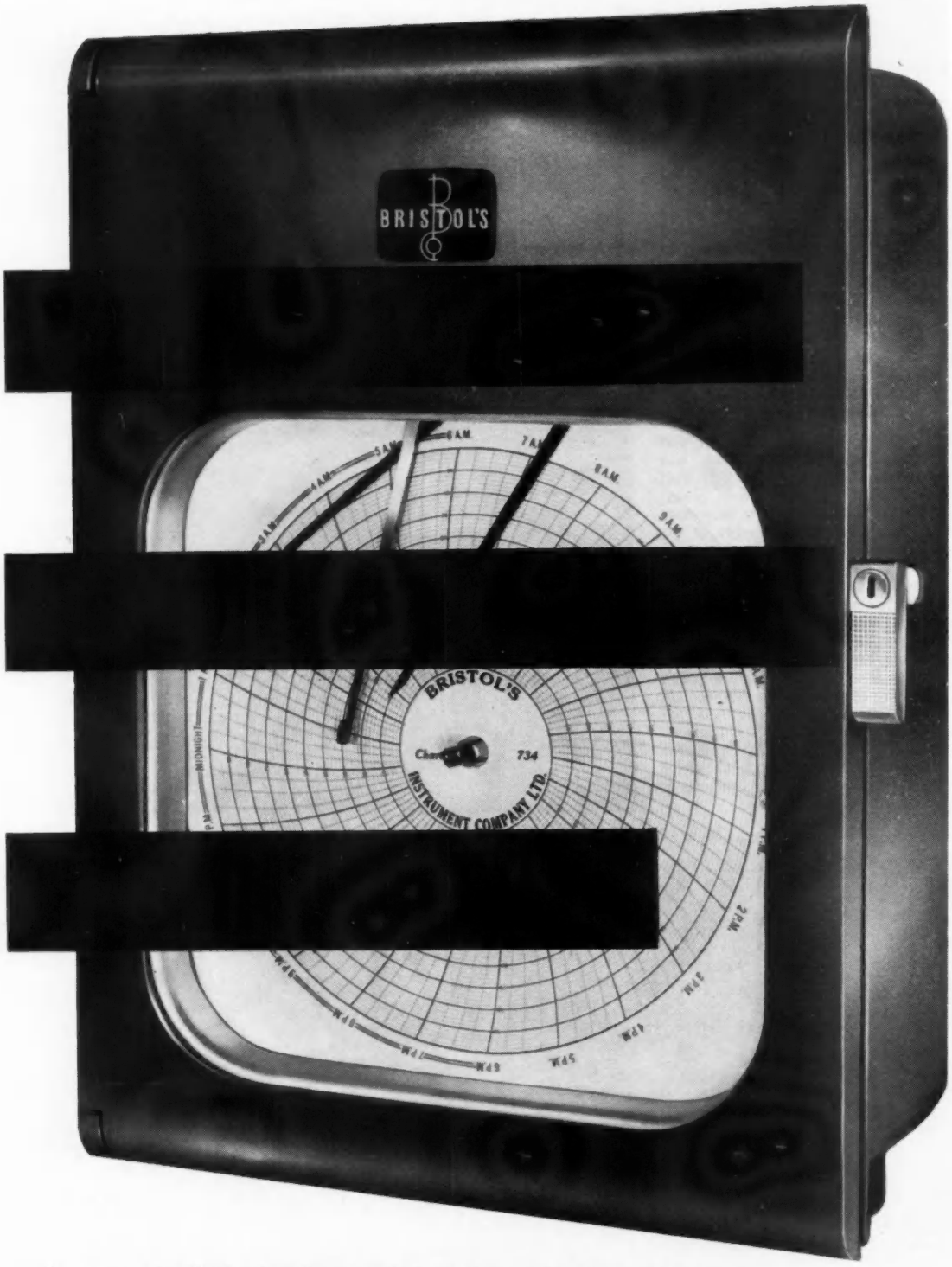
At the conclusion of the tour the guests were entertained to tea in the new, second floor building recently added to the assembly department block. This building had been specially decorated for the occasion and included an attractive display of the appliances manufactured by the Glover & Main Group.

Waterways of Thermain No. 15 and New Junior water heaters under test in the water testing bay.



Non-ferrous components are seen undergoing polishing prior to chromium plating.

'Camel back' conveyor stoving oven in which painted components are treated after being sprayed.



As each link is forged in the chain of area integration schemes, Elliott-Bristol's Telemetering is selected for automatic control and supervision.

ELLIOTT BROTHERS (LONDON) LTD., CENTURY WORKS, LONDON, S.E.13 (TIDEWAY 3232)

Century Works

Elliott Bros. (London) Ltd.

New buildings housing the process control division at the Lewisham Works of Elliott Bros. An extensive modernization programme has been carried out during the past year.

WITH headquarters at Lewisham, two large branch establishments at Rochester and Borehamwood, two smaller ones at Weymouth and Blackheath, and a payroll of more than 4,000, the firm of Elliott Bros. (London), Ltd., traces its history back to 1795 when William Elliott was apprenticed to William Backwell of Sash Street, Grays Inn, London, a compass and drawing instrument maker. The original indenture, still carefully preserved, can be seen by visitors to the company's Century Works at Lewisham.

Ducal Magic Lantern

Five years later William Elliott founded the present company, and after 30 years of successful trading, making among other optical and precision instruments, a 'large Magic Lantern (34s.) for Her Grace, the Duchess of Wellington,' he took his two sons into partnership, and moved to the Strand. In 1853 the founder died, and eventually the son Charles retired, leaving Frederick Elliott to carry on the success story until 1873.

During the following period until 1900, the company closely associated itself with the growing development of electrical machinery, and advanced navigational equipment.

Award Gained

Among the many varied instruments shown in an 1895 catalogue is an arithmometer, which gained the award offered by the Prudential Insurance Company for the best English-made arithmometer. This early piece of office machinery was used by many of the largest insurance companies and bankers, and makes a contrast to the more highly complicated machines being produced by the company today.

Century Works was opened in 1900, exactly one hundred years after the founding of the business, and it was from this factory that the first British motor-car speedometer was produced. It was exhibited at the Motor Show in 1906.

There are now 14 main divisions in the company: Process control division, electrical measuring instruments division, Fisher division, aviation division, mechanical engineering division, Bendix division, systems division, Servo components division, nuclear division, computing division, microwave division, radio and radar division, guided weapons division and research division.

Development and Production

The premises at Lewisham cover an area of about seven and a half acres, and the total floor area of the various buildings is some 200,000 sq. ft. This space, apart from administrative, sales and similar functions, is devoted to the development and production departments of process control, electrical measuring instruments, Servo components, nuclear, systems, and mechanical engineering divisions. There is also a large showroom where sample equipment is installed for demonstration to customers, and a lecture room where various instructional courses are run for service engineers, representatives of customer firms who require training in operation and maintenance of Elliott equipment, and apprentices.

Sub-divisions Formed

As the instrument requirements of industry became more complex, separate sub-divisions of the main process control division were formed, each staffed with specialist application engineers who made a study of the requirements of the industry or group of industries with which they were associated. These groups are known as the boiler, food, iron and steel, oil and chemical, rubber, and gas divisions.

The full research and development resources of the company are available to these specialist groups, and all new developments and designs are either based on the requirements and advice of the application engineers in each field, or are studied by each industrial team to see if outstanding and difficult problems are brought nearer to solution by any advancement in instrument design or application.

Resources Exploited

The gas division, serving the needs of the industry in the production and distribution fields, has made full use of these available resources, and, in close collaboration with the American (Bristol) company, has marketed the now well known metameter multi-channel remote indication and control apparatus.

Automatic Control

The advance of data-processing techniques in recent years has led to much more detailed study than previously of the problems of entirely automatic process control, using electronic computers and associated equipment to increase the speed and accuracy with which corrections can be applied when some parameter departs from its required value. The Elliott systems division is constantly engaged in studies of this nature, and is able to advise on the best type of overall system to suit any specified conditions. There is available a considerable selection of analyzing and computing units which, together with the comprehensive ranges of Elliott measuring and recording instruments, make it possible to plan fully automatic control loops for a great number of applications.

In this connection, a particularly interesting equipment recently developed

is the Elliott digital readout, which automatically scans any desired plant measurement data at regular intervals and then types out, with an electric typewriter, the readings it has taken. If any of these readings differs by more than a given amount from a predetermined value, the readout equipment will type it in red so that it is immediately obvious, and if required will also sound alarms, close down the process or, in the most advanced applications, cause the appropriate remedial action to be taken.

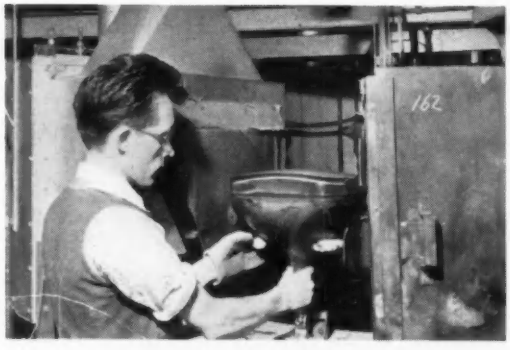
Needs of Gas Industry

It is, of course, often necessary for instrumentation and control to cover a plant or system which is spread over a very wide area, and nowhere is this more important than in the gas industry. Elliott and Bristol data-transmission systems are widely used for such applications, each installation being individually planned and set up by the gas division.

Though Elliott products have application from the farm to the furnace, from the laboratory bench to the battleship, one constant factor is the maintenance of the highest qualities of craftsmanship, of ingenuity and of precision set by the founder, William Elliott and his sons, on which the organization has been built, and on which its future must depend.

Pictured, right, is the interior of one of the new workshops.

Mullard Radio Valve Works



VISITORS to the Mitcham, Surrey, works of the Mullard Radio Valve Co., Ltd., were able to see, among other things, how that modern miracle, the cathode ray tube—the heart of their television receiver—is manufactured.

Development and production of valves, cathode ray tubes, and electronic tubes of all types is carried out by the Mullard Company. The factory operates with three subsidiary or feeder factories at Whyteleafe, Surrey, and two at Hove, Sussex.

Also at Mitcham are various laboratories, amongst which are several engaged on measurements and applications relating to the employment of valves and tubes in all types of circuits. In addition, production of semi-conductor devices is undertaken.

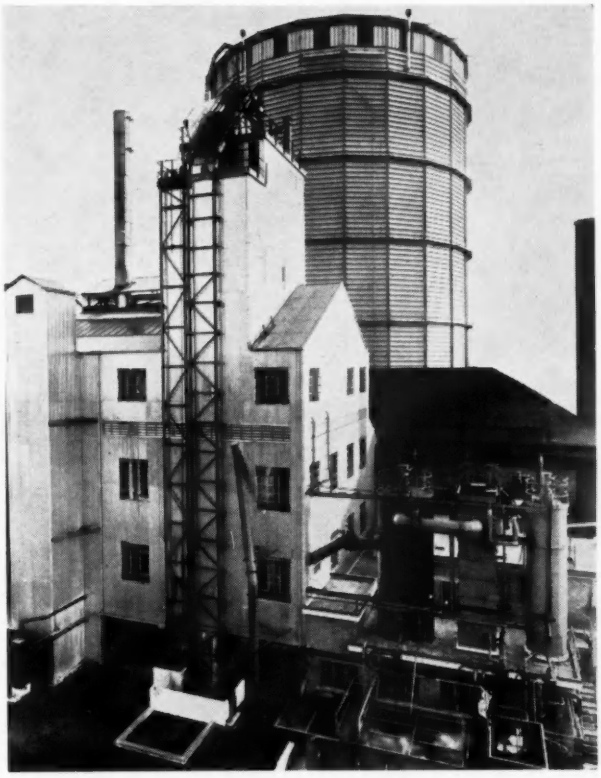
Pictured at left, an operator at the Mullard works loads a sealed-in tube on to an exhaust station preparatory to baking and evacuation. Below, the process of pumping photocells is seen in operation.

Kensal Green

Complete Gasification Plant

ALTHOUGH numerous examples of complete gasification plants incorporating the Gas Integrale System have been built on the Continent, the Kensal Green installation is the first plant built in accordance with that system in this country. The plant comprises essentially a generator on which is superimposed a coal predistillation shaft, and operates on the well-known blow-and-run principle. By the use of oil carburetting equipment the calorific value of the gas made can be varied from about 330 up to over 500 B.Th.U. per cu.ft.

Grouped round the generator itself are the principal ancillary vessels, namely, the regenerative steam superheater, tar fixing chamber, carburetting and oil fixing chambers, hydraulic seal and waste heat boiler. The air blower, gas exhauster and pumps are separately housed, the gas cleaning equipment being situated on the pump-house roof.



External view showing gas house on left and gas cleaning plant on right.

Resembles Water Gas Generator

The lower portion of the generator resembles in most respects a modern water gas generator and incorporates a low pressure jacket boiler with separate steam drum. The rotating grate is of the dry-sealed type, allowing high blast pressures to be used, and delivers ash and clinker into two pockets which are emptied once a shift.

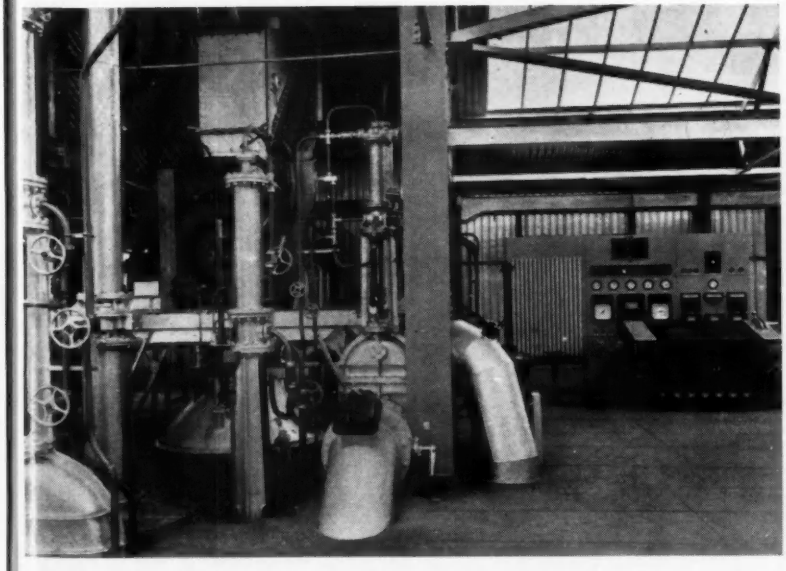
Surmounting the generator is the refractory-lined predistillation shaft, in which the descending coal is carbonized by the sensible heat of the rising water gas produced in the lower gasification zone. This shaft is divided into sections by hollow radial walls through which the blow gases circulate during the blow period, so providing a further supply of heat for carbonizing the coal.

The regenerative steam superheater and the tar fixing, carburetting and oil fixing chambers are all refractory-lined steel vessels fitted with conical bases for dust removal. The hydraulic seal, which has a conical bottom to facilitate cleaning, incorporates a bell which is lowered during the blast period, so providing an additional forward seal.

The plant is capable of being operated on either an up-run or a back-run cycle. In either case there is a blow period during which air is forced beneath the grate and blow gases are burnt in the usual way with secondary air to heat the ancillary vessels, the combustion being completed with tertiary air just before the waste heat boiler.

When employing an up-run cycle the regenerative steam superheater is in service, and the run period commences with the admission of steam to the base of that vessel; the highly superheated steam, at a temperature of over 700°C., is then led from the top of the superheater through a refractory-lined main and admitted to the generator below the grate. The water gas so formed passes up the pre-distillation shaft, imparting its sensible heat to the column of coal, and leaves the generator vessel at the top carrying with it the volatile matter of the incoming fuel.

When no carburetting is being practised the crude gas passes direct to the hydraulic seal and away to the gas cleaning plant. If, however, carburetting is required, the gas enters the tar fixing chamber where it is reheated to a suitable temperature before meeting the oil sprays in the carburetter.



Generator top level with automatic operator and control panel to right.

Back-run Cycle

If a back-run cycle is employed the regenerative steam superheater is not in use. In this case the up-run part of the cycle is similar to that described before, except that the process steam is admitted directly beneath the grate. During the back-run, which follows the up-run, the steam enters the generator at the top of the gasification zone after being highly superheated in the fixing and carburetting vessels, the water gas made leaving the generator at the base.

The plant is completely automatic in operation and is provided with comprehensive instrumentation.

Ham House, Petersham.

Ladies Get Away From It All

Visits to Country—Places of Interest—Fashion Show

AS usual, the official programme included special arrangements for the ladies designed to take their thoughts—for a time—away from the gas industry. There were visits to the country and to historic buildings; there was a dress show; and an exhibition of needlework. And, of course—for no ladies' outing would be complete without it—each event included afternoon tea.

Few more delightful buildings could have been chosen for one of these visits than Ham House at Petersham. Standing serene and majestic beside the River Thames between Twickenham Ferry and Richmond, Ham House is a particularly happy example of early 17th Century domestic architecture.

Finest Collection

It was for many years the home of the well-known Tollymache family—the Earls of Dysart. Soon after the last war it was presented, together with much of its original furniture and interior ornament, to the National Trust, and has been open to the public since the spring of 1950. The furniture, which is maintained in good order by experts of the Victoria and Albert Museum, has been described as 'probably the finest and most varied collection' to survive from the reign of Charles II.

Two other visits made by the ladies were to that architectural extravagance in Brighton, the Regency Pavilion (pictured at the foot of the page) and to Penshurst Place, birthplace in 1554 of Sir Philip Sidney. This last was the highlight of a coach tour through the delightful Sussex countryside and on into the Kentish Weald—tea was taken at Hildenborough.

The dress show was held in the ballroom of Grosvenor House, Park Lane, by arrangement with Harvey Nichols & Co., Ltd.; and the exhibition of needlework took place at the headquarters of the Institution where the guests were entertained to tea by Mrs. W. K. Hutchison.

★

Regency Pavilion Brighton.

★

CARBONIZATION

the

essential

basis

for

Clean Air

CARBONIZATION

WEST'S CARBONIZING SYSTEMS

C·O·L INTERMITTENT VERTICAL CHAMBERS

the economical basis for Carbonization

GLOVER-WEST CONTINUOUS VERTICAL RETORTS

COLLIN COKE OVENS

WEST'S GAS IMPROVEMENT COMPANY LIMITED
ALBION IRONWORKS · MILES PLATTING · MANCHESTER, 10
Telephone: COLlyhurst 2961. Telegrams: Stoker, Manchester
AND IN LONDON
Columbia House, Aldwych, WC2. COL Div. Chandos House, Buckingham Gate, SW1.

C

INSTITUTION BENEVOLENT FUND

MR. W. K. HUTCHISON, C.B.E., the Chairman, presided at a general meeting of the contributors to the Benevolent Fund of the Institution.

The Honorary Secretary (Mr. W. T. K. Braunholtz, O.B.E.) read the notice convening the meeting, and the minutes of the general meeting held on May 25, 1955, at Southsea were taken as read, confirmed and signed.

The Chairman moved that the report of the Committee of Management of the Fund for the year 1955-56 and accounts for the year 1955 be taken as read and adopted.

Mr. W. S. Hubbard seconded the proposition, and the motion was carried.

Mr. A. G. Grant and Mr. L. P. Ingram had been duly elected to serve on the Committee of Management for the three years 1956-59, announced Dr. Braunholtz.

Mr. J. T. Haynes, O.B.E., said that it had for many years been a privilege to be associated with the Benevolent Fund, and he was indeed proud that morning to express thanks to the Chairman and the Committee for their work.

He went on: 'Of all the committees associated with the Institution, I think this one is by far the most difficult. It is dealing not with theories or experiences but with human beings, and human beings who, because of the circumstances, are peculiarly sensitive and need very careful handling with sympathy and understanding, and with discretion.

On behalf of the contributors to the fund, he expressed their thanks, and on behalf of the recipients he would express thanks for the sympathy and understanding with which their claims had been dealt.

Mr. N. R. Junkison, in seconding the vote of thanks, said they should record a very hearty vote of thanks to the Chairman, the Committee of Management and the Secretary of the Benevolent Fund into whose hands they placed the responsibility of administering the contributions.

Mr. Junkison said: 'You have seen that only slightly over half our members contribute to the Benevolent Fund. The number of cases assisted last year was 23. In 1938 when the membership of this Institution was only half its present numbers, the number of cases assisted was 28. The accounts would show a very different picture if the Fund were called upon in the same proportion to the membership as was the case before the war. This may be an indication of the increasing prosperity of ourselves as gas engineers, but I suggest that this should not be relied upon. Perhaps, on the other hand, it is due to the restrictions that we lay on the Committee. I suggest that we should increase our subscriptions and give them more assistance.

'In the London and Southern Junior Gas Association, we feel very strongly that the function and purpose of the Junior Associations is not only to educate the younger members of this profession by giving them the opportunity to widen their technical knowledge, but also to educate them in the other parts that go to make up the whole of a good gas engineer, and in that we include the practice of charity.

'I put it to those present that you should express your approval of this vote of thanks not only by acclamation but by taking steps to make the task of the Committee of Management an easier one in the future by far more substantial support than is at present given to it.'

The vote of thanks was accorded with acclamation. The Chairman thanked Mr. Haynes and Mr. Junkison on behalf of the Committee of Management.

Results of the S.B.G.I. Golf Meeting

AT the S.B.G.I. Spring Meeting, held at the Royal Mid-Surrey Golf Club, Richmond, on May 28, Mr. G. J. B. Cox won the Coronation Plate with a score of 38⅛ (he is shown below receiving his trophy from the President), Mr. C. T. C. Woodall won the Thornton Cup with a score of 38¼, Mr. S. C. Thomson won the Davis Cup with a score of 38⅛, and Mr. J. Ramsey won the Visitors' Prize with a score of 38⅞. Winners of the foursomes were Mr. S. C. Thomson and Mr. I. M. O. Hutchison, who finished all square, and Mr. C. R. Averill carried off the Booby Prize. On the right is the Captain of the Circle, Mr. C. A. Macleod.

President's Luncheon

Variations on a Nursery Theme

The Minister, the President—and Cinderella

A friendly duel for the hand of Cinderella was fought by the Minister of Fuel and Power and the President of the Institution at the President's Lunch on May 29. Or perhaps it was that the President wanted the Minister to become a Fairy Godmother instead of a Wicked Uncle—we are a little confused. The reader had best judge for himself . . .

The Loyal Toasts having been honoured, **The Chairman,** in proposing the toast 'The Guests,' referred to the principal guest, the Minister of Fuel and Power. This was a special occasion, he said, because they had Mr. Aubrey Jones with them for the first time since his appointment. He wanted to offer him their good wishes for success in his arduous and difficult office and assure him of the unfailing support of gas engineers everywhere. The Minister was accompanied by his Permanent Secretary, Sir John Maud, whom they all knew and liked so much, and by a number of others of the Ministry staff, including their own Mr. Owen Francis. Mr. Hutchison also referred particularly to the presence of M. Nerot, the President of the French Association, Dr. Gummert, Mr. Wood Prince and Mr. Murphy. He also welcomed his colleagues on the Gas Council who were all members of this Institution, and of whom no less than eight were 'Chartered' Gas Engineers. Equally important and just as welcome were the Chairman and Secretary of the Society of British Gas Industries, representing the contracting and appliance side of the industry. Their guests included the honorary members of the Institution, among whom he personally and warmly welcomed Sir Harold Hartley and Mr. Birks, to both of whom, in different ways, he owed so much. Mr. Hutchison also had a special word of welcome for the members of kindred associations, and especially Mr. Wallace, President of the Institution of Civil Engineers, with whom they collaborated closely in the training and education of the gas engineers of the future. The many other guests included those who had assisted the Institution in the past year and one of the Institution staff, Mr. Higgins, the Assistant Secretary, who was their guest as President of the Illuminating Engineering Society. Finally the President welcomed Mr. B. R. Jackson, the Chairman of the British Petroleum Company, and the Press, to whom they owed so much for the careful and sympathetic reporting they gave to all the activities of the gas industry and of the Institution.

Uninhibited Opportunity

The opportunity presented by this luncheon and the welcome presence of the Minister of Fuel and Power would be an opportunity missed if he did not express in an uninhibited way and without any authority whatever some of the views which he held about the gas industry. The Minister was far too astute a Parliamentarian to be drawn into any controversial issues. The gas industry was sometimes called the Cinderella among the fuel industries and had accepted this role quite cheerfully, knowing that all fairy stories come to a happy conclusion and confident in the knowledge that Cinderella would eventually meet the Prince. But he went on, Cinderella had two ugly sisters, who were much favoured by their father, while he appeared to have held some such position as Chancellor at the court and always gave these ugly sisters the best and most glamorous outfits and the best and largest slice of the capital development cake.

Ashes of Despair

Picture then poor Cinderella cleaning the ashes from the grate—it was even rumoured round the court that one of her sisters had put the ashes there. They had told her that one day after the passing of the necessary legislation she would have one of the new smokeless fuel grates, but her hopes were really centred on a gleaming new automatic self-lighting and time-controlled gas-fired central heating installation which would allow her to go out dancing all night. It was a completely vain hope, because her father was himself suffering from credit restriction and he could not raise the 20% first instalment on the hire purchase, and in any case he was the kind of reasonable man who objected to paying purchase tax on a gas heater when he could get an oil or coke fired one free of tax.

Now he came to the happy part of the story. Fortunately, there had recently been a few changes and a newly-appointed Fairy Godmother had come on the scene. Waving her magic wand, she told Cinderella to dry her tears because everything was going to be all right in future and she would have just as much cake as her sisters and all the best and most glamorous clothes with which to advertise herself. At this stage, said Mr. Hutchison, he thought it better to leave the fairy story, because the Minister of Fuel and Power was going to reply in due course.

Turning now from fairy tales, in which he was an expert, to economics, of which he knew absolutely nothing, they would all know only too well that odious child in its brighter than white dress on all our hoardings, learning its first lesson in social superiority over the child whose mother presumably still uses soap or else another firm's detergent.

It had been pointed out quite recently by an economist that by the skilful and unrestricted use of advertisement on the largest possible scale and with no immediate regard to planning or the public good, the detergent industries were able to convert the British housewife to the contents of their glossy packages and so release to undernourished nations far more fats and oils than could have been produced by the whole of the groundnut scheme if it had been practicable, which it was not! This example was presented only in order to lead up to the suggestion that if the gas industry were given a free hand and encouraged to develop in all the directions which it thought fit and by methods in which it was a past master, the resulting economies in the use of fuel might go far to bridge the gap which they knew existed and was always tending to widen in the nation's fuel supplies. True it was that coke had been acknowledged to be the only effective way to a smokeless age, but it seemed to him that the claims of gas, with all the convenience which it offered and by far the lowest sulphur content of any generally available fuel, were in danger of being overlooked and its use discouraged by various fiscal measures.

Concluding with matters which were quite beyond controversy, he paid a warm tribute to the Institution staff and especially to Dr. Braunholtz, without whose assistance and sound advice—and even sometimes firm controlling hand—the office of President would be impracticable: also to the members of his Board and the Board's senior staff, without whose support and assistance he could not have fulfilled the duties of that office.

The Bloom Fades

Responding, **The Rt. Hon. Aubrey Jones, M.P.,** Minister of Fuel and Power, said that the President had been rash enough to liken the gas industry to Cinderella. But if he remembered the fairy story rightly, Cinderella had about her the bloom of youth, and he was not quite sure that that description applied today to the gas industry! But it was true that Cinderella was of a meek, gentle and most virtuous disposition. The Minister of Fuel and Power saw these industries for the most part only when they caused him trouble, but he met the gas industry only on happy occasions like this one. As for the rôle he had been given—that of a fairy godmother—he had some great difficulty in explaining the facts with the fiction. According to the fairy story, the Fairy

Godmother was godmother to one child only—Cinderella; that was an easy job. But he had the misfortune, if misfortune it be, to be godmother to the two—he could not apply any adjectives!—sisters as well. Therefore, it behoved him to be impartial. Much though he would like to remain outside controversy, he could not help but listen to the brawls which sometimes took place.

It was not true that in the story the Fairy Godmother did nothing but wave her magic wand. She did on occasion indulge in a little admonition. As a godmother to more than one child in real life, he supposed he must follow the precedent. And since they were indulging in a talk between godmother and godchildren—an uninhibited talk—it was not inappropriate possibly to talk about the gas industry, its past and its future.

Expansion, Maintenance, or Contraction

Since the war the gas industry had been hard put to it to maintain its position. It had in some directions expanded its frontiers, but by and large it had just maintained its position, and the question now was, what should be its future? Should it be one of contraction, of continued maintenance, or one of expansion?

He was sure they would all rule out contraction, and he hoped they could also rule out maintenance. They were left with the only other course, one of expansion; and he was sure that that was the objective which the gas industry must set itself.

What were the chances of expansion? Of all nationalized industries the gas industry was the most decentralized, and experience had shown that the structure was one most admirably suited to their needs. This was an enormous advantage and he strongly urged them to use this advantage to the full.

But there was also another advantage. Their competitors—other fuels—all had their individual cushions of monopoly. Coal, for instance, had a natural monopoly in steam raising; oil in road transport; and electricity in motive power. But the gas industry had no natural monopoly, no cushion. That was an advantage, because surely, from this existence in a competitive world there must stem a resourcefulness and a resilience of spirit, and in the end it was on the industry's spirit that its future must depend. But it had against it memories and the temptation to succumb to sheer memory. It had a past, an expanding past, an expansion which had now turned to stability. Quite naturally, in this transformation there was a feeling of a sense of grievance, a hankering after re-creating the circumstances which gave rise to the initial expansion.

He was not sure that he did not trace one or two gleams of this nostalgia in the President's remarks, and certainly he had come across traces of the same nostalgia before in his talks with the gas industry. There was, for instance, Sir Harold when he raised the whole enormous question of the structure of coal prices. He had been exhorted to change the structure so as to help the gas industry in its circumstances. Having gone most carefully into this question, and recognizing that the gas industry used coal with great efficiency, he could not but also recognize that the coal which it used was a coal of high quality, increasingly scarce, and increasingly costly to procure. Surely, it was on these two things—quality and cost—that the price of coal must depend and not so much on the use to which the coal was put?

If he were to vary the price of coal according to the uses to which it was put, he would have so many prices varying according to so many different customers and producers. No! Despite all his desire to help the gas industry, he was forced to the conclusion that the price of coal was based on sound principles, and he was satisfied, too, that the National Coal Board, in applying these principles, applied them fairly to the gas industry.

It was not in a change of the structure of coal prices that they must seek salvation. Rather, if he might quote a sentence from the President's address, he would say that it was essential to master what he called 'this coal/coke/gas price situation.' One of the things that had heartened him was to hear of the manner in which they were, in fact, mastering this situation. They were resorting increasingly to carbonizing lower rank coals. Two Boards had made great progress in this direction. Clearly, this was a development of very great significance, because this development, pushed further, could release the high-quality scarce and costly coals to meet the growing needs of the steel industry.

Godmotherly Benevolence

Apart from this resort to coal of a different quality, he had heard much about resort to different raw materials—oil, gas drained from mines, and the transportation of liquid methane. Whether Mr. Prince would indeed prove to be the Prince of the fairy story he could not say; but clearly the industry was showing most promising new developments. He took it that it was because of these developments that in his address that morning the President had set before the industry the objective of providing a complete house service by gas. He had said: 'The technique is there. The techniques remain to be worked out.' He supposed they would include among the techniques the procuring of godmotherly benevolence on his part, and possibly a more fatherly interest on the Chancellor's part.

He invited them to work on him as much as they liked, and he promised that he would prove most susceptible, subject to one condition—impartiality towards his other godchildren too.

Progress came about by moving into the unknown and the untried, by creating new sets of circumstances. That was the path of advance, and he was quite sure that he was speaking for all the guests when he said that for their part, that was the path which they would like to see the industry follow. And he was sure that he spoke for them, too, when he wished them all success in what must be a most adventurous quest.

Sir Harold Hartley, K.C.V.O., C.B.E., M.C., M.A. (Honorary Member), proposing the toast 'The President,' said that some 30-odd years ago he had persuaded the President that there was a future in the gas industry. He confessed that among the inducements of its possibilities which he had offered him on that occasion it had not occurred to him to suggest that one day he might be President of this Institution. Those amongst them who were of the older generation would realize that at that time he certainly did not contemplate that his destiny would lie south of the Thames! It had been a great pleasure to watch him since those days go on from strength to strength with that charming personality that smoothed out difficulties, with his imaginative grasp of the problems of the industry, and his initiative and his Scottish sagacity. Of course, he had made history, because he was the first Oxford graduate who had been President of this Institution. It was very fitting that next year he would be succeeded by Sir Henry Jones, who came from the other 'shop.'

Close-up

Mr. J. Hunter-Rioch and Mr. Norman Smith.

Mr. F. B. Holmes and Mr. E. D. Copley.

Mr. J. Davidson Pratt and Mr. D. Beavis.

Aromatics are to your car what seven-league boots were to the Giant . . .

Aromatics are the things in a motor spirit that have extra built-in miles to the gallon . . .

Aromatics are what National Benzole Mixture has twice as much of

NATIONAL BENZOLE high-aromatic MIXTURE

THE MOST MODERN OF ALL MOTOR SPIRITS

NB4/

National Benzole Co. Ltd., Wellington House, Buckingham Gate, London, SW1. (The distributing organisation owned and entirely controlled by the producers of British Benzole)

Abstract of I.G.E. Communication 486

Post-War Development of East Greenwich Works

By C. STOTT, M.C., B.Sc. M.Inst.Gas E., M.I.Chem.E., A.R.I.C.,
Deputy Chief Engineer, South Eastern Gas Board.

WORKS development replacing existing plant or providing for substantial extensions should fall within a master plan determined by the characteristics of the site. The plan would cover the current projects due to be completed within five years, provide for more general proposals for development covering a further ten years, and, most difficult of all, allow a general provision for the undetermined future.

The works layout initiated in 1883 by George and Frank Livesey on a site of 96 acres was a striking example of planning. The site of the jetty took account of the navigational problems for shipping rounding Blackwall Point. The location of the retort houses was determined partly by the convenience of coal transport from the jetty and partly by the decision to build them broadside to the river. They were much concerned that these decisions should not prejudice future development, however remote.

It is a fitting tribute to their far-sighted intention that today the capacity of East Greenwich has been raised to 72 mill. cu.ft. per day, and the very substantial block of plant in the form of coke ovens and carburetted water gas plant, with their considerable auxiliaries, have been readily fitted into chosen positions inside a general arrangement which, in itself, permitted full freedom in layout and design.

Obsolete Benches

Following the last war, the South Metropolitan Gas Company was faced with the need to renew carbonizing plant on a major scale. At East Greenwich with a rated output of 36 mill. cu.ft. per day by its carbonization in horizontal retorts of 2,700 tons of coal, 1,800 retorts were set in 12 similar benches of 15 settings each. Three of these benches were virtually obsolete, five were in fair condition, and the remaining four were modern.

This stage of planning coincided with the change to public ownership, and the transition brought a significant technical change in the adoption of a standard calorific value for this part of the country of 500 B.Th.U. per cu.ft. A Wobbe Index range of 700 to 760, which was proved suitable for existing district appliances, with a permissible variation in specific gravity of 0.43 to 0.51, made possible the admixture of coal gas and carburetted water gas in approximately equal proportions, and it provided the answer to the balance of plant required to meet the problem of the seasonal diversity in load.

The calorific value of the crude coal gas as produced can be taken as 590 B.Th.U. per cu.ft. with a reduction to 550 B.Th.U. per cu.ft. after stripping for benzole and allowing for air admitted to the oxide purifiers.

By plotting the average daily demand expressed as a percentage of the mean day throughout the year, a balance of manufacturing plant required to meet the seasonal load throughout South London can be arrived at. On this basis, the balance arrived at is (thermal) coal gas 51.4%, B.W.G. 6.4% and C.W.G. 42.2% to give relative proportions of types of gas produced per year per 100 therms of annual output as coal gas 68.9 therms, B.W.G. 8.5 therms and C.W.G. 22.6 therms, and load factors for carbonizing and C.W.G. plants as 94.5 and 45.1% respectively. In accordance with the Board's policy of integration of manufacture at selected works, the next stage of development at East Greenwich was decided on, and the new plant, recently completed, comprises coal gas—coke ovens (4 batteries) 24.0 mill. cu.ft. per day—and C.W.G. (eight generators) 27.2 mill. cu. ft. per day.

These are the nominal rated outputs, which can be extended by 10% to meet peak loads. (Additional production of 18 mill. cu.ft. per day is still available from the six horizontal retort benches that remain. This coal gas will be balanced by the installation of further purification plant.) The East Greenwich development thus represents a closely integrated installation of modern plant, and with the production units are the associated ancillaries, wet purification plant, oxide purification plant, power house, water-tube boiler plant and river water pumping scheme.

Major developments are normally carried out in successive stages and these should be carefully planned in size and sequence if capital is to be employed to the best advantage. Planning on the major scale implies a great reduction in the number of works required. Large-scale development on a favourable site brings the very pronounced advantages of the maximum freedom of choice in the overall planning of the plant, methods, services and utilities, and the adoption of big units, particularly of electrical and mechanical plant, is a definite economy in first cost and in process and maintenance labour.

On large-scale projects, it has been found possible to devise advantageous arrangements for carrying out the work. A major project can be readily subdivided into sections representing the various branches of engineering work. This approach tends to outline more clearly the special nature of the problem within each section, and leads to the closest consideration of alternative materials and methods. It also includes the witnessing of functional tests of machinery at the makers' works to ensure that it is capable of performing the specified duty. The inspectors act as a liaison between the contractor and the Board's engineers in the settlement of constructional and technical queries that arise. This co-operation can be of great assistance to both parties, as faults detected during production are more readily rectified at that stage than when the whole work has been completed. Progressing of work is a natural adjunct to inspection and is an invaluable asset in the planning of overall completion to schedule.

East Greenwich is a prime example of these principles. The works jetty is admirably suited to receive seaborne coal and, previous to the present development, the annual intake was some 800,000 tons. This can be raised to 1,250,000 tons with the same labour and without further expenditure on the jetty and its cranes, or on the coal-conveying and -handling system.

Description and Working of the Plant

The coal is discharged from ships by grabbing cranes and loaded to buffer hoppers on the jetty. It is then conveyed inshore by belt conveyor to the primary crushers, which reduce the coal to below 2 in. The crushers discharge to a buffer hopper serving a main belt of 400 tons per hour capacity, at the terminal of which a tripper discharges to the blending bunkers. These consist of six vertical cylindrical bunkers, each of 32 ft. diameter and 74 ft. high and of 1,200 tons capacity, constructed in reinforced concrete. Alternatively, the coal can be passed to field stock. The coal is elevated by inclined belt conveyors to the service bunker 162 ft. above ground level.

The coke oven plant consists of four similar batteries. They were erected by Simon-Carves and each battery is of 22 ovens. The batteries were designed for a throughput of 500 tons of coal per day each and this has been readily attained on a com-

fortable carbonizing schedule and at a low level of carbonizing temperature.

The service bunker, in reinforced concrete, holds 3,000 tons of coal. The coal charge required is obtained by adjustment of the telescopic sleeves on the four charging funnels and its weight is automatically recorded.

The main dimensions of the oven are: Length over sole, 44 ft. 7½ in.; height, 12 ft. 6 in.; width, coke side, 1 ft. 5 5/16 in., ram side, 1 ft. 3 in.

The ovens are of the twin-flue compound type and are heated normally by producer gas, but underjet firing is employed when heated by coal gas. The term twin-flue indicates an arrangement whereby the heated gases pass up one flue and down the next flue in the same oven wall, a very short portway connecting the tops of each pair of flues.

Swelling Effects

High-silica refractory material was used for the oven walls, sole work, and the top five courses of the regenerators. The sole course itself is in 'Cindrils' firebrick specially chosen for its resistance to abrasion. When the oven design was being considered, the coals normally supplied from the North East Coast were examined for swelling effects, and were found to be within the limits of safe working, provided that segregation was avoided and the bulk density of the coal limited by suitable size reduction. In this enquiry into the suitability of coals for use in ovens, it appeared that there was no single method by which a dangerous coal could be defined with certainty. These factors, together with considerations affecting coke quality, led to the decision to crush the coal to less than ½ in.

The weight charged to each oven is 14¼ tons; the unit of manning is two batteries or 44 ovens, and their rated capacity of 1,000 tons of coal per day is obtained on a schedule of 68 charges per day. At periods of additional demand, the schedule is increased to 72 to 75 charges, thereby raising the coal throughput to 1,067 to 1,106 tons per day. During the low demand period at the height of the summer, the schedule has on occasions been dropped to 57 charges or 840 tons of coal per day. The normal schedule of 68 charges per day gives a gross carbonizing period of 15¼ hours for an oven of 16 in. width; on the peak schedule of 75 charges, the time is reduced to little more than 14 hours. Routine operation and maintenance involves the standing by of each oven for 20 minutes between discharging and charging, and one oven per day from each pair of batteries (44 ovens) is stood off for a further 20 minutes in order to clean off doors, flash plates, ascension pipe valves and covers. For the year ended September 30, 1955, the three batteries at work carbonized 543,369 tons against their rated capacity of 547,500 tons.

When the original design of the coke oven plant was being considered it had been decided against self-sealing doors. In 1951, it appeared that Gustav Wolff had produced an improved door with a redesigned sealing strip. This was inspected at the maker's works in Germany and in use at two separate plants. The strip is a drastic departure from earlier design, and screw pressure had been abandoned. The new strip is a simple mild steel flat 2¼ in. by 7/16 in. with the sealing edge chamfered to ⅛ in. It is clamped to the machined edge of the door casting by L-shaped bolts at 6 in. pitch. Once the clamping bolts have been pulled spanner tight to grip the sealing strip, no further adjustment of the bolts is ever required.

The coal gas leaves the ovens through ascension pipes and collecting mains on both sides of the batteries. The ascension pipes are refractory-lined and of 15-in. internal diameter. They are connected to the collecting mains by special pipes fitted with isolating valves to seal off the ovens during discharging and charging operations. A liquor spray is positioned at this point passing 15 gal. per minute (say 2,000 gal. per ton of coal carbonized), which flushes the isolating valve. The two collecting mains from each pair of batteries enter a common 54-in. diameter main leading to the wet-purification plant.

A quenching tower is provided at each end of the installation for each set of 44 ovens. The tower chimneys are 100 ft. high and 16 ft. 6 in. diameter, and both the hoods and chimneys are lined with acid-resisting tiles. The quenching water is held in a storage tank at high level and is led to the water sprays through a 10-in. diameter cast iron main. A quick-acting hydraulically operated valve on the supply to the sprays is opened automatically by the coke car as it enters the tower and the sprays then discharge at a high rate for a controlled period, usually of 65 seconds. The excess water drains to settling ponds, where the entrained breeze is deposited, before being pumped back to the storage tank by either of two 600 gal. per minute centrifugal pumps. The first quenching tower to be built incorporates a perforated pipe system of water distribution and uses 4,000 gal. of water per charge, while the second tower, built later, uses 3,200 gal. per charge through a group of six sprays adjustable in any direction. The spray method is not only more economical in water, but gives more uniform quenching and a closer control over the moisture content of the coke. Three coke cars with electrical locomotives are provided, two in use and one as stand-by. On the car track system, convenient arrangements are made for a lay-by and repair bay. Both the tilting and non-tilting types of coke car are in use. The latter is to be preferred, as it is simpler and also gives cleaner working. The maximum speed of the coke car locomotive is 8 m.p.h., and, as the weight of the loaded train is some 90 tons, these units are equipped with compressed-air brakes. The locomotives carry an air compressor with auto-pressure switch starter, air cylinders, regulation-pattern train pipes and brake cylinders to provide a powerful and rapid braking system.

On the coke side, there are three door extractor machines, which incorporate the trailing coke guides; again, two are at work with one stand-by. The extractor design has been modified to give a more robust construction and a smoother manipulation of the door.

Two ram machines are provided, one for each pair of batteries. The ram rack on both beams is underdriven. The first ram to be installed revealed an undesirable feature in the combined pinion and front rollers.

A separate coke wharf serves each pair of batteries. As the belt conveyor taking coke from the wharf cannot conveniently be duplicated, a permanent belt-changing mechanism is provided to expedite the changing or repair of the belt. Forward of the wharf conveyors, all units of the plant are in duplicate to facilitate maintenance and ensure continuity. After cooling and drying on the wharf, the ungraded coke is fed to the cutters which are set to reduce all coke to below 3 in. The coke is then elevated by an inclined belt conveyor to the screens installed on a reinforced concrete floor covering the storage hoppers. A travelling crane and permanent lifting tackle are available for servicing the screening plant.

From the storage hoppers, the various grades may be loaded through side shoots to rail wagons, or through adjustable feed trays to a belt conveyor. This conveyor feeds a distributing tower from which the coke may be delivered by belt to the sales hoppers, the producer plant, the carburetted water gas plant, or the main boiler house.

Producer Gas Plant

On coke oven plant, the efficiency of heating, the employment of regeneration, the close control of heating flue temperatures and the long life of the ovens all depend on the use of a clean fuel gas of consistent quality supplied at a constant predetermined pressure. These requirements were met by the installation of mechanical producers using graded coke as fuel with arrangements for washing, cooling and cleaning the gas produced, and for the regulation of the pressure of its supply to the oven heating system.

Due to purely local considerations, a special condition was imposed on the design of producer. The general scheme of reconstruction at East Greenwich embodied the electrification of the works with the generation of power in a central power house utilizing at that stage of development the works steam pressure of 160 lb. per sq. in. In order to make good the works steam and power balance without the addition of new boiler plant, it was stipulated that the producers should incorporate boilers capable of raising steam at that pressure, superheated to 500°F. The Humphreys & Glasgow gas producer was adopted as meeting these requirements. On a producer rating of 25 tons per day of coke sized between 2 in. and 1 in., it was expected that 5,400 therms of producer gas would be made at a calorific value not less than 122 B.Th.U. per cu.ft. with a cold gas efficiency of not less than 75%, and that the steam raised at 160 lb. per sq. in. superheated to 500°F. would be not less than 1¼ lb. per lb. of coke fed to the producers.

The producer fuel is delivered by a series of belt conveyors to overhead hoppers capable of storing rather more than the maximum day's usage. The fuel is fed to the producer by an automatic feed delivering a pre-determined quantity at regulated intervals, normally of seven minutes.

Ash removal is automatic, the grate and bowl revolving against a fixed plough. The ash discharges on to a belt system and is conveyed to the main ash hopper, which holds a day's production.

Each producer is provided with its own scrubber consisting of an unpacked spray tower 45 ft. high and 7 ft. diameter, a shallow layer of 'Raschig' rings at the top acting as a spray arrester. The scrubbing water is drawn by local pumps from the river water supply main and is delivered at 50 lb. per sq. in. pressure to the sprays. The cooled gas leaving the scrubbers is finally cleaned from dust and fog in plate-type electrostatic precipitators.

The producer gas boosters, like the air blowers, are motor-driven with stand-by steam-turbine units coming automatically into operation on failure of power. The pressure in the supply mains to the ovens is automatically controlled. As the working blowers and boosters are driven by constant-speed A.C. motors, the volume control in each case is achieved by the operation of butterfly valves in the air main and the producer gas main. This control system, which performs the function conventionally entrusted to a relief holder, has worked well and is best suited to multi-battery installations. The plant, consisting of 12 producers of which 10 are usually under blast, is conveniently housed in a steel-frame building.

The producers consume 9.71 lb. of dry, ash-free fuel per 100 lb. of coal carbonized. They have given continuous satisfactory service and readily accept 10% overload without impairing the standard of performance.

The installation is self-contained and consists of eight Humphreys & Glasgow sets, each capable of producing a maximum of 3.4 mill. cu.ft. per day.

Experience at Sydenham in the use of heavy oil on carburetted water gas plant has indicated that the tar produced is even more prone to form an emulsion with water than the tar produced from gas oil. The addition of a small proportion of 'Amine 220' to the liquor supply to the wash box has been found very effective in preventing this formation of emulsions, and an independent tar and liquor separator was provided to segregate the tar. It has also been found that, when carburetting heavy oils, blockages can arise in water-tube condensers through the deposition of pitch-like substances at the cooler end. To avoid this, provision was made in the condensers operating on the gas from heavy oil for the cooling water to be kept above a minimum temperature of approximately 80°F., and for flushing of the final gas passes with liquor.

Full use is made of the waste heat to generate steam at 160 lb. per sq. in. pressure in the waste-heat boilers of the plant and at 40 to 45 lb. per sq. in. pressure in the annular boilers of the generators. The higher-pressure steam drives the turbines of the air blowers and gas boosters, and the exhaust augments the lower-pressure steam to serve the process requirements.

Detarrers

Three W.W.-D. tubular detarrers, each of 7 mill. cu.ft. per day capacity, free the gas from tar. Naphthalene is removed from the gas in four five-bay rotary washers operating in parallel. The spent wash oil is used for carburetting. Two Connersville meters measure the whole of the gas produced. From the meters, the gas passes to two parallel streams of dry-luted box purifiers, originally used for coal gas purification, and then joins the debenzolized coal gas at the inlet of the mixed gas boosters, for transfer to the station holders.

The quantity of carburetted water gas admitted to the coal gas can be automatically controlled, by a butterfly valve, to produce a mixed gas at the declared calorific value.

Crude gas from the ovens passes through two 54-in. suction mains, each taking the gas from 44 ovens and terminating in a downcomer sealed in a catch tank in which the tar and liquor travelling with the gas is removed. The gas then passes into the wet purification plant, supplied by Whessoe, Ltd., and arranged in the sequence: Five primary coolers, three turbo-exhausters, five secondary coolers, four electrostatic detarrers, six static ammonia washers, two Connersville meters, and two gas heaters.

This plant can be divided into two streams, either of which is capable of treating the gas from 44 ovens. To allow for increased coal throughput and variations in gas output due to intermittent charging, and for air entrainment coincident with smokeless charging, each stream was designed for a maximum gas rate of 653,000 cu.ft. per hour (15.67 mill. cu.ft. per day) when measured saturated at 60°F. and 30 in. mercury pressure.

Two 26-in. by 78-in. Holmes Connersville meters, each having a nominal rated capacity of 625,000 cu.ft. per hour, provide means for measuring the gas passing down each of the streams. The gas leaving the wet purification plant passes to the oxide purifiers by a long overhead main, and, to avoid the possible deposition of naphthalene, two indirect gas heaters are installed to raise the temperature through 36°F. if required, so that the gas remains unsaturated in respect of naphthalene.

Break with Practice

Two streams of tower purifiers by W. C. Holmes, Ltd., are installed to purify the coke oven gas. Each stream consists of six working towers, a stocking tower to receive the trays of fouled oxide when any tower is emptied, and a stocking frame to hold a set of trays recharged with fresh oxide to replace the trays removed. In the first stream, five of the towers are connected for backward rotation, with the sixth tower serving as a catch; in the second stream, all six are connected for backward rotation. This represents the steps in the break from the long-established practice of employing four primary boxes followed by two catch boxes. All eight towers of both streams are provided with connections for purging with waste gas, generated from coal gas, at the rate of 15,000 cu.ft. per hour, in a static machine housed in a building adjacent to the site. Air, previously metered, can be passed into any of the working towers for revivification *in situ*. Open steam can be admitted to the gas stream at the inlet of each working tower.

The new plants at East Greenwich and Phœnix Wharf have been arranged so that, where practicable, the steam required for process and heating purposes is obtained from the exhaust of prime movers of the back-pressure or pass-out type.

Previous to the developments described in this paper, the works took its supply of cooling water from the reservoir formed by the conversion of the old Blackwall Dock. Penstocks to the river were opened when the tide rose to the level of the stored water, and were closed at high water. The water flowed by gravity through twin 36-in. mains to open pump wells at convenient points on the works. To conserve the supply, the water from the gas-cooling system was passed through rack coolers and returned to the reservoir, but despite this the net supply to the works was limited to 70,000 gal. per hour which barely met requirements, particularly on neap tides. The planning details of the works development made it clear that the new water requirements were very greatly in excess of the old, and it was equally clear that no attempt should be made to adapt the existing facilities to meet the new demand.

The particular needs of the new plant were an increased supply of boiler feed water and water free from salt for coke quenching. The possibility of sinking a well to secure an adequate water supply was considered and it was realized that the pumping of water from wells in the London Basin generally had resulted in a progressive fall in the water table and a dwindling supply. A study of the history of local wells showed that wells south-east of the Greenwich Fault had quite acceptable records of supply. This is due to the fact that the water-bearing chalk is found 100 ft. nearer ground level on this side of the fault. In consequence, a well was sunk a mile from the works to a depth of 300 ft.

At East Greenwich, the economic case for the new plant has never been in question, and the advantage is specially accentuated in that manufacturing methods wholly confined to horizontal retorts have been replaced by a balanced system of coke ovens and water gas plant.

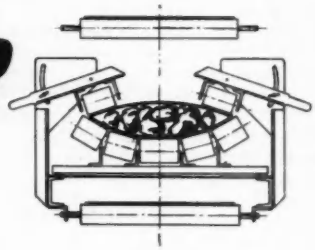
The actual capital cost of the various sections of plant is about £5½ mill., but, as there were incurred at varying price levels between 1947 and 1955, the actual costs have been adjusted to the cost indices for plant and engineering works as at December 31, 1955. On this basis the capital cost would be about £7½ mill.

Although the costs refer to the 51.2 mill. cu.ft. per day composite coke oven and water gas plants with their ancillaries,

"Conveying and Elevating at 35°!"

by

BLANKET CONVEYOR



CROSS SECTION OF BLANKET CONVEYOR

This 30" Blanket Conveyor recently installed at the BOW COMMON WORKS of the NORTH THAMES GAS BOARD, conveys 50 tons per hour of run of retort coke at an angle of 35 degrees. *It is equally suitable for handling coal.*

A BLANKET CONVEYOR costs little more than an ordinary conveyor to reach the same height and occupies approximately half the space. It is as easy to maintain and as dependable as a conventional conveyor.

Photograph by courtesy of North Thames Gas Board.

ROBERT CORT & Son Ltd

READING · ENGLAND

Telephone: Reading 5046 (5 lines) Telegrams: "Corts, Reading"

a part of the coal-handling, steam-raising, power-generation and distribution and river-water-pumping capital expenditure benefits the old plant retained outside the new development. On the other hand, the new plant enjoys the advantage of using works facilities, the capital value of which has long since been written down. In order to present the capital aspect more clearly, a firm estimate largely based on recorded costs has been made for a 72 mill. cu.ft. per day riverside works based on coke ovens/water gas plant parity.

The capital cost of such a plant would be about £13¾ mill. At this stage of development, it is not possible to give an unqualified figure for the cost of manufacture, but the net cost into holder for coke oven gas is 6.32d., and for carburetted water gas 10.78d. On these figures, the net cost into holder of the mixed gas was 7.30d. for the year ended September 30, 1955.

When considering these statements in order to arrive at a total cost of manufacture, the following points should be taken into account:—

(1) Over the period of the accounts, the installation of plant, both ovens and carburetted water gas, were only 75% complete.

(2) Capital charges on the basis of a complete new works at current prices would be 2½d. per therm made. The actual charges are considerably less at approximately 1½d. per therm.

(3) Welfare charges are ½d. per therm, and general charges above works level ¼d. per therm.

(4) Works general charges at 1.23d. are in respect of the whole works, and on the basis of a completely modern works would certainly not exceed 1d., and ¾d. would be a reasonable target.

(5) The cost of gas treatment, 0.47d., is the average for the whole works, and this includes the results from both the old and new streams. It is estimated that a reduction of 0.15d. would be shown for gas treated in the new wet purification and oxide purification plant.

(6) Current prices for coal, coke and breeze are respectively 14, 22 and 47% higher. Their application to the net cost of materials for coal gas produces no significant change.

After considering these factors in relation to the actual net cost into holder, a reasonable estimate for the total cost of manufacture of the mixed gas would be 9.96d. per therm.

DISCUSSION

Mr. D. T. Barritt (Managing Director, Simon-Carves Ltd.) said Mr. Stott had shown that it paid to make gas on a large scale. He had also shown that to meet seasonal variations in demand, the base load could be taken by coke ovens and the variation by gasification plant of approximately equal capacity. It was clear from the paper that provided the operating conditions were sensibly and systematically controlled, great regularity in performance of coke ovens could be achieved year in year out and that they formed an ideal base load plant. The use of coke ovens for this purpose in Great Britain was rare and he therefore proposed to confine his comments to the coke oven section of the paper.

Most Economic

When the project for the integrated works was considered in the early stages, the South Metropolitan Gas Company, as it then was, came to the conclusion on theoretical grounds that coke ovens would provide the most economic and suitable base load plant for their particular conditions. Their knowledge of the more conventional gas making methods was very considerable but they had had no direct experience of coke oven plant. It was therefore natural that the capabilities of coke ovens and their design should come under a more searching review than was usual when coke ovens were built at collieries and steelworks.

Features of design which collieries and steel works' people and designers usually took for granted were critically examined from first principles and many changes were suggested to suit the Company's engineering standards and methods of working. This was a useful and instructive procedure for both the designers of the plant and the Gas Company. The results were embodied in the first two batteries of ovens. The experience of operating these two batteries was available before the last two batteries were ordered and was applied to the design of these later ovens.

It was interesting to recall briefly the matters which required investigation before the first two batteries were ordered and the result of these investigations on the design of the plant. It was equally interesting to examine the changes in design resulting from operating experience with the first two batteries and the reasons for these changes.

It was realized from the outset by the Gas Company that coke ovens would offer low operating and maintenance costs and long life at a high rate of performance. It was also known from previous tests on the Company's coals in coke ovens that the gas yield and calorific value requirements would easily be met. What was not known was whether these coals would be dangerously swelling when carbonized in a coarsely ground condition at high coking speeds, how the coke would compare with the domestic grade made in horizontals in respect of its combustibility and what effect such variables as oven width, carbonizing temperature and coal grading would have on the properties of the coke produced. The height, width, and throughput of the oven chambers could not be settled until an answer to these questions had been reached.

Expansion Tester

As regards swelling properties of the coals, at the time the Russell oven—the moveable wall oven—was not available in this country. In any case, it was not calibrated for British coals. The only means at hand was the Koppers expansion tester, a small apparatus developed on empirical lines but nevertheless reasonably reliable in expert hands. This apparatus showed that at normal charging densities all the Durham gas coals to be used were safe under any conditions of working. However, at the higher charging densities possible with coarser grinding at least two of the coals appeared to be border-line cases. In such circumstances these coals would naturally not be used by themselves but it was nevertheless felt to be prudent to take such precautions as were available in design against such a possibility. It was decided therefore to limit the height of the oven chamber to 12 ft. 6 in., which was a modest height for a coke oven today, and the decreased height to breadth ratio of the oven wall so obtained gave a greater stability against lateral pressure. In practice, so far as he knew, no difficulties with swelling charges had arisen, but he still considered the additional capital cost of the precaution to have been well worth while.

The effect on coke quality of oven width, carbonizing temperature and coal grading was investigated extensively in test ovens of different widths and in full scale working. It was found first, that at temperatures normally employed in coke ovens oven width had little effect on the shatter index of coke, its size or its combustibility; secondly, that the lower the carbonizing temperature and the coarser the grinding the better the screen analysis and the more reactive the coke; thirdly, that within limits practicable with coke ovens changes in carbonizing conditions did not significantly affect the bulk density of the coke; fourthly, that it was not difficult in test oven work to produce a coke containing three volatile therms per ton because the finishing temperature of the centre of the charge could be accurately controlled; and finally, that a coke little different from that made in horizontal retorts could be made in coke ovens operating under normal conditions on the same coals.

Small Difference

For practical reasons the choice of oven widths lay between 16 in. and 18 in. It was realized from the experimental work that the difference in performance between the two would be very small, but the 16 in. oven was finally chosen because the same rate of output could be obtained with a slightly lower carbonizing temperature. A normal coking time of 15.5 hours was decided upon. Having decided the height, the number of ovens in the two batteries was then determined at 44. On that coking time, the normal pushing schedule—the number of ovens discharged—was 68 ovens per day, which was comfortably within the capacity of one set of machines and one crew of men. The coke ovens battery thus made a compact and easily worked unit and,

as was clear from Mr. Stott's figures, its performance in practice easily met the designed figures.

In the design of the third and fourth batteries of ovens ordered in 1950 and 1954 many minor modifications were introduced but only four changes were made of a major nature. First, it was decided to abandon the tilting coke car because although it was supposed to give a low moisture content in the coke—as it probably did—the mechanical complication was not thought to be worth while. We put in the ordinary standard fixed coke car. The second change was from the luted doors to the latest type of self-sealing doors, giving a saving of labour, cleaner operation, and less arduous labour for the men. Thirdly, the twin-divided regenerator oven was employed instead of the three-divided regenerator type. With the latter upstream lean gas and downstream waste gas compartments were not adjacent and leakage between the two was impossible. With the former, the two compartments were adjacent but were separated by a special interlocking wall which remained gastight. The main advantage of the change was that the structure at oven sole was simplified and strengthened. Fourthly, the design of the oven wall was changed to include header bricks of a simplified hammer head design. This design was sturdier than the original and commonly used bottle brick design, although this latter in practice had given no trouble.

In practice it could not yet be said whether these changes had been worth while. Time would show. So far as present experience went there was little to choose between the first pair of batteries and the second pair.

Dependent on Conditions

It was commonly stated that if each oven in a battery has carbonized 100,000 tons of coal before renewal or major repair its performance could be regarded as satisfactory and anything above could be thankfully taken as a bonus. The only advantage of the figure—which would give the East Greenwich ovens a 'life' of only 12 years—was that it was easy to remember. The life of coke oven battery brickwork, in actual fact, depended on conditions which varied widely from plant to plant. For example, for a coke oven battery working steadily on easy coals at moderate temperatures and with good management and maintenance, 150,000 tons per oven would not be regarded in any way as abnormally high and had many times been exceeded. On the other hand, a coke oven battery working on difficult coals at fast coking speeds and handicapped by irregular working, bad operating habits, and poor maintenance, would do well to reach half this figure before it needed attention.

For the Greenwich ovens, whereas there were considerable variations in load on occasions, the factors were in favour of long life. As was clear from the paper, great care had been taken with the quality and laying of the brickwork, the coals were dry and carefully controlled, the operating temperatures were moderate, and an efficient system of maintenance had been evolved as a result of experience.

Most coke oven batteries, where there were no special and insurmountable difficulties, ultimately failed at the oven ends because of the repeated thermal and mechanical shock of removing and replacing the oven doors. It was considered until comparatively recently that a complete brickwork rebuild was then unavoidable. The brick work could be renewed in six months. This meant six months from the time you went out of production until you were back again. This was a considerable dislocation. A technique had, however, been evolved whereby the oven ends up to four or even more flues in could be rebuilt while the oven was under heat, with the batteries still at work and still in gas. He had seen batteries successfully rebuilt up to six flues in. Such repairs, on experience so far available, remained effective for about 7-10 years and had in some cases been repeated. A recent advance in cement technology had made available a cement which could be used to joint hot brickwork because it remained plastic until the brick was properly laid. This had enabled a repair to be done in which the whole of the oven faces from foundation pad to oven top, up to a distance of four flues in, were successfully renewed with the ovens hot. Present estimates of oven life were thus likely to be conservative, and obsolescence would become more important than condition in determining a plant's future.

Mr. F. M. Birks said that in starting, the author had quite categorically stated—and then gone on to prove—that in order to obtain economy in capital it was most essential that wherever possible the largest size of units should be used. As one who had subscribed to this ideal for many years, this seemed an opportunity of comparing what had been done at Greenwich with what had been done in other places. The electrical industry seemed to use turbo-generators of 100,000, 50,000 and 30,000 kWH capacity. If we took 20 kW as the equivalent of one therm, dealing with peak loads in both industries, which were space heating, then the equivalent gas plant capacities were 16, 8 and 4.8 mill. cu.ft. per day. The large turbo-generator was virtually a base load set owing to the time required to get on to the line from cold. In our industry one often heard quoted the difficulty of accommodating very large sets to the make, but he ventured to suggest that this was somewhat exaggerated.

Quickly Out of Date

Take, for instance, the carburetted water gas plants dealt with in the paper. The original scheme included eight sets of 3.4 mill. cu.ft. per day each. These seemed quickly to have been felt to be out of date, because for the second plants units of 6 mill. cu.ft. were installed. Had not the time arrived when we should be thinking in terms of 12 mill. cu.ft. per day or over?

If we took the producer plant for firing the ovens, these had been provided of small size and in large numbers. He agreed that this was today almost standard practice, but need it be?

He was very interested in the paragraph about the difference between the luted and the self-sealing door. About 25 years ago, ovens in which he was interested were fitted with self-sealing doors because it was estimated that there would be a great saving over luting. When he first saw the plant at Greenwich he was surprised to see that they had reverted to luting and he wondered whether his previous confidence in self-sealing doors was not misplaced. Having no luted doors with which to compare them, they should be very grateful to the author for giving the result of his experience.

Coke Quality

On the question of coke quality, it might well be that the present great interest in the subject might start a swing to intermittent vertical chambers, particularly for use with non-coking coals, because the economics so greatly depended on the degradation of graded coal to breeze. The chambers discharging by gravity should reduce the breeze formation to a lesser degree than static plants discharging by means of powerful pushers.

He was surprised to see that Group III flame-proof standard motors were used in buildings where gas might escape, and for larger ones an internal air pressure was maintained. Any motor as specified by the author was capable of running indefinitely in the open, and to put all electrical equipment outside such a building was always possible and considerably safer and cheaper.

Would the author give a little more information on the working of the tower purifiers? What was the total time required to change the oxide in a box and to prepare the discharged oxide ready for placing in the next box? How long did they remain in the towers and was there any difficulty in discharging the trays?

Mr. H. D. Greenwood (National Coal Board) said he had read Mr. Stott's paper with very special interest since it was over 30 years ago that he first took up an appointment at the East Greenwich works under the former South Metropolitan Gas Company. To have suggested anything other than horizontal retorts in those days would have been considered almost heretical, while a sure way of changing your employer would have been to suggest some electrification of the works.

Times had changed, but despite the new look which had been given to the old works, the basic layout of the works was more or less unchanged. Indeed, as Mr. Stott had pointed out in his paper, it had not materially changed over 70 years since it was planned by the Livesey brothers. It was a sobering thought in these days of so-called planned economy that our great grandfathers could plan, and plan wisely, for perhaps 100 years ahead, and did it more or less as a matter of course.

Although widely adopted on the Continent, the suitability of coke ovens as

gas-making plants had always been a debatable subject in this country. The results given in Mr. Stott's paper left no doubt as to the suitability and economy of coke ovens for gas production, however, he had not said much about the quality of the coke which was produced. Oven coke, particularly from Durham coals, was not generally regarded as suitable for the open fire. He would be interested to know whether the coke from this plant was regarded as suitable for this purpose. He noted that a large proportion of the coke was of the larger sizes which were put down in the paper for industrial consumption, and so he assumed that the majority of the coke was not expected to go into the domestic market.

No Coal Blending

He was interested to note that, although blending bunkers were installed, coal blending in 'the usual sense' has not been found to be necessary He would have thought that since a wide range of coals was used blending would have been advantageous if only to give more uniform charges to the oven operation and also to maintain a more consistent coke quality. In this connection he would be interested to know the types and ranks of the coals normally used. He gathered that they were Durham coals, but there was a wide range available from Durham. The carbonizing time of 14-15 hours was low compared with normal coke oven practice, although the volatile in the coke and the temperature employed were similar. The coke and breeze yield was lower than was obtained in Durham, which was 13.07 cwt. as compared with an average of 14 cwt. in the N.C.B. plants. The breeze yield was high at 9%, but he presumed that that was after cutting to under 3 in. The normal breeze from Durham coals in coke ovens was more like 4%.

They had been told that the normal practice at East Greenwich was to push 68 ovens per day or 22.7 per shift—for each machine. In one of their new N.C.B. plants they push 26 ovens per shift with the one machine, and another plant was designed to push an oven every eight minutes. Their normal procedure was to employ seven men per shift on a 1,000 ton per day plant. He would be interested to know how that compared with the manning of the East Greenwich plant.

It was sometimes suggested that the most economical size of unit was 1,500 ton per day and not 1,000 ton per day, on the basis that you could get 1,500 tons operated with one machine. He wondered whether this point was considered by Mr. Stott and his colleagues when planning the plants.

It was always difficult to compare costs as between one works and another since costing methods were never the same, but he had been interested to see that the operating costs at East Greenwich were 2.6d. per therm as compared with 2.4d. and 2.3d. per therm at their new coke oven plants, carbonizing 1,000 tons per day. They were operated under different conditions, and the costing might be quite different, but the figures were very close.

He would have liked to compare capital costs, but Mr. Stott had not given separately the capacity of the coke ovens. The new N.C.B. plants were costing us about £47 per therm per day. This was a green field site and hence would not be directly comparable with the author's estimates. He says that his cost of gas into holder was in 1955 about 6.3d. per therm excluding capital charges. The cost of making producer gas appeared to be about 7d. per therm, excluding capital charges, and he wondered if it might not be more economic to change over to rich gas firing in periods of low demand instead of reducing throughput of coal in the ovens. The difference in cost, however, might be only marginal.

He had been very impressed with the detailed investigation which had been undertaken into each part of the plant before deciding upon the design and type of plant to be adopted. The excellent results which were being obtained were the reward for such a detailed study, which he knew had spread over a number of years. He was quite sure that one could not devote too much attention to detail in the planning stage and a large new project.

In the N.C.B. they had built three completely new coking plants, two of 1,000 tons per day and one of 2,200 tons per day, in the past few years, and had three more under construction, and so they had a very good idea of just how much work was involved in carrying out these projects.

When he had been in the former South Metropolitan Gas Company they used to pride themselves on the results obtained with horizontal retorts. He was sure that Mr. Stott and his colleagues, who would well recall those days, would feel happy that they had carried forward the former standards of efficiency, in both design and operation, in the new coke oven plant.

'Extremely Suitable'

Mr. George Dougill congratulated Mr. Stott in following in the foosteps of the Gas Light and Coke Company by installing coke oven plant at Greenwich for the base load coal gas. He was sure that for large scale carbonization under the conditions of load, coal, labour, and coke demand, coke ovens were extremely suitable for both Beckton and Greenwich.

He was rather surprised at the diagram showing the base load coal gas plotted as a horizontal straight line over the period of the year. They had found that by suitable planning of their resetting work, thus spreading it from early spring to early winter, the so-called base load coal gas line could be made to cover quite a large proportion of the increased winter load, that is, the maximum amount of base load plant was available each winter and the minimum each summer. This made the best use of the plant, which produced the cheapest gas. Also, he did not agree with the statement that the load factor of carbonizing plant could be 94.5%, since resetting and other major repairs usually accounted for 10-13% loss of capacity. He was also surprised that the water gas plant had been divided into such a large number of small units for a system such as that of the Metropolitan area, and he would have thought that at least a 6 mill. per day unit would have been more suitable.

In connection with coal handling, he noted that the coal was crushed as received. He could appreciate many advantages from this course, but he was averse to crushing coal before placing to stock. Crushing increased the surface area of the coal and hence increased the rate of oxygen absorption. This increased the rate of depreciation of the coal and its liability to spontaneous heating, though he agreed that consolidation of the heaps tended to minimise both these factors.

Much could be said on the design of the ovens, but he would confine himself to two points. The Greenwich ovens were 16 in. wide, and the Beckton ovens 18 in. wide. This undoubtedly gave a shorter coking time, which was partly balanced by the reduction in the capacity of an oven. He agreed with the author on the importance of the relative level of the top of the heating flues and the charge of coal, and the levels given showed that they agreed on the optimum figure. He would point out, however, that different relative levels could be used since a relatively low flue level could be balanced to a large extent by higher flue temperatures and a shorter carbonizing time, and the general custom in the coking industry appeared to lean in this direction.

He was pleased to see that Greenwich had been converted from clay luted doors to the self-sealing type. He was sure this was the right policy. Their experience over 25 years confirmed it.

From their experience, trouble would be expected from naphthalene deposits in the ancillary plant described in the paper. In their system they used reversible primary condensers so that any naphthalene deposits could be readily removed. The exhausters were then followed by detarrers and naphthalene washers. The complete removal of naphthalene at this stage ensured that the secondary condensers, ammonia washers, purifiers, and all following plant remained clean and capable of efficient operation over the long periods between the resetting of batteries.

As a matter of interest, he calculated from the data supplied their estimation of the capacity of the tower purifiers installed and found that on their basis they would consider these suitable for 23-24 mill. cu.ft. of gas per day continuously and under all conditions. This, of course, meant that they should be capable of an overload of up to 25-30% under good conditions. They had had so much experience with split flow of gas in purifiers that they would have no worry whatever at the thoughts of passing gas through only an 8½ ft. depth of oxide. This had been their normal condition for years.

The **President** said that in view of shortage of time he would ask Mr. Stott to reply to the discussion in writing.

Abstract of I.G.E. Communication 488

Domestic Utilization of Gas and Coke

By L. W. ANDREW, B.A., B.Sc., M.Inst.Gas E.,

Director, Watson House Centre.

A PAPER given by Watson House to the Institution of Gas Engineers in 1945* considered the part gas and coke should play in the provision of post-war domestic heat services, recommended suitable combinations of gas and coke for this purpose, and estimated running costs.

The present paper considers the technical implications of national fuel policy since then, new data on practical fuel consumptions, and the effect of developments in appliance design. Special importance is attached to the field tests carried out at Abbot's Langley by the Department of Scientific and Industrial Research.

It is believed that technically the case for the increased use of gas and coke, and particularly of gas, is even more firmly established than in 1945.

Special attention is directed to the following points:—

(*a*) For full occupancy, the original assessment of consumption of gas for complete space heating of houses was on the low side. In practice, however, particularly for flats, the case for gas space heating is strengthened, as periods of use may be limited.

(*b*) Practical consumptions as a whole tend to be lower than those estimated for a full service. This emphasizes the need to quote consumptions solely in relation to the service assessed.

(*c*) Changes in fuel cost have improved the competitive position of gas in relation to solid fuel.

(*d*) There are many situations where gas is competitive with solid fuel for an all-the-year-round hot water service.

(*e*) There are real possibilities of a substantial increase in practical thermal efficiency of convector gas fires, convector coke fires, and gas water heaters.

(*f*) Combined gas and coke appliances for space heating and water heating should be reconsidered in order to allow a flexible service at a low capital and installation cost.

(*g*) New methods of flueing could help to simplify the installation of gas appliances.

(*h*) Attention should be directed not only to appliances for the low income groups, but to a higher standard of heat service for those who can afford it.

The paper includes some new examples of combinations of gas and coke and of all-gas heat services for houses and flats.

In the last 10 years, the gas industry has maintained the great bulk of domestic cooking, but the desired pattern of use of gas for other purposes has not been achieved to anything like the desirable extent.

While the fuel consumptions quoted in the paper referred to are substantially correct for the assumed standard of heat service, field tests show a tendency for many people to be satisfied with a lower standard of service with a resultant saving in fuel costs when using the more flexible fuels. Another important factor is the change in relative prices of gas and coke. The various tables of running costs quoted in the previous paper were for 1939 prices; on the basis of costs for 1955 there is a closing of the gap between the costs of a gas service and a gas and coke service. Table 1 shows the effect of this factor on the earlier examples of providing heat services in a particular house by five different methods using varying proportions of gas and coke.

TABLE 1.—*Examples of Changes in Running Cost of Gas and Coke Installations (1939 to 1956)*

Specimen dwelling with three bedrooms, dining-room/kitchen, living-room (900 sq. ft. floor area)

HEATING SYSTEM.—All samples have gas for cooking, laundry, refrigeration, and hall and bedroom heating.

No.	Details of Installation	Costs for 1939 and 1956 taking sample 1*c* as 100%		
		1939	1956	
			(*a*)	(*b*)
1*a*	Coke boiler, coke fire Gas sink heater for summer	103	110	112
1*b*	Coke boiler, coke fire Gas sink heater and circulator for summer	106	111	112
1*c*	Coke fire with back boiler Gas sink heater and bath heater for summer	100	100	100
1*d*	Coke fire Quick-recovery gas storage heater Flueless convector in linen cupboard	133	123	115
1*e*	All gas with instantaneous multi-point for water heating and a flueless convector in linen cupboard	147	127	109

Prices taken are:—

1939	1956
Coke (per ton) .. 45s.	163s. 2d.
Gas (per therm) .. 9d.	(*a*) .. 21.85d.
	(*b*) Two-part tariff—£1.7s. 9d. per quarter standing charge and 16.85d. per therm.

It should also be remembered that, while many households are concerned with obtaining a reasonable service at a minimum cost, there are still many others who are prepared to pay more for a better service and for greater convenience in use.

Space heating is the major domestic heat service, as it is always necessary to provide reasonable comfort for long periods in at least one room. There will, however, be very large variations in practice in the amount of fuel used, as this depends so much on the habits of the occupants and the amount of money that they are prepared to pay. Recommendations are complicated by two opposing factors: the one is the legitimate criticism of the standard of heating normally accepted in this country, and the other the national problem of conserving our fuel resources. As far as new houses are concerned, this compromise can be achieved partly by improved standards of insulation and the extended use of controlled ventilation in the form of chimney restrictors or restricted throats for many types of solid-fuel appliances. Unfortunately, owing to the limitations of capital expenditure in the building of new houses, these new standards have rarely been achieved in practice, and, of course, they represent more serious difficulties in the case of existing houses.

An immediate saving in fuel resources could, however, be achieved by a wider use of gas and coke appliances and, in particular, by the wider use of gas for mild weather heating

* Technical Aspects of the Gas Industry's Contribution to Post-War Housing. Andrew, L. W., Dunning, E. W. B., Holliday, G. C., *Trans. Inst. Gas Eng.* 1944-45, **94**, 308.

and intermittent use. It is doubtful if full attention has been paid to the importance of the full flexibility of a heating system in a climate as variable as ours and with our living habits which need an intermittent heating system. The tests at Abbot's Langley* show that it is necessary to provide really adequate heating in the living-room and in one bedroom; if this is done, the general heating of the house will be satisfactory. Here again, restrictions in building expenditure have reduced the flues available in new housing, whereas the presence of a flue in the living-room and in the main bedroom is a necessary requisite for the provision of proper heating services.

Developments have taken place in the design of gas appliances which improve the position of gas relative to solid fuel. It is now largely accepted that the convector gas fire is the correct gas space heating appliance for a living-room or for any other room occupied for several hours. In 1945, only one such fire was available, but there is now a choice of fires from six manufacturers, and the position of the convector fire has become established. The ideal gas fire is one which is not only of high efficiency, but has a wide range of turn-down in order to take full advantage of the flexibility of gas. These fires have not yet reached the optimum efficiency that should be obtainable, largely because of restrictions imposed by existing designs and dimensions of solid-fuel fireplaces. There has been a tendency to base convector gas fires on conventional gas fires and it is necessary to fit them into conventional fireplaces. The possibility now being considered, of free-standing convector fires to be fitted into a recess and not a fireplace, may well lead to a substantial increase in overall efficiency without any increase in capital cost.

Another new development is the balanced-flue radiator in which a flued source of mainly convected heat achieves an overall efficiency of about 75%. Such appliances do not give the advantages of a radiant heater, but they do represent a very interesting competitor to any form of central heating as they provide a greater degree of flexibility than could be obtained from a central source and are under the control of the individual tenant. A special use is to provide background heating in a hall or kitchen, and in practice there are many situations for which they are easier to vent than an appliance with a conventional flue.

Gas central heating installations are primarily of interest to the higher-income groups.

The sale of domestic coke, although increasing, has lagged behind the installation of the appliances suitable for burning it. A market survey carried out in London has shown that approximately one in four improved open fires burn coke only; the remainder burn mixtures of coal and coke, or coal only. It is clear that the increased sale of solid smokeless fuels has not achieved that advocated by the Simon Committee. Developments of the free-standing coke fire have proceeded much more slowly than was hoped for. However, the competitive position of coke in relation to coal has been established not only by laboratory tests, but by field tests, including those at Abbot's Langley, which show that 16 cwt. of coke will in nearly all appliances give the same service as 20 cwt. of coal. Developments in coal-burning appliances have shown some promise of a reduction in smoke emission, but this does not make them acceptable as an alternative to coke for smokeless zones.

Heat Services by Gas and Coke

Houses

The most comprehensive field tests available are those at Abbot's Langley, and Dick analyzed these in terms of a figure for mean house temperature in a paper to the Institute of Fuel in May, 1956.† These results form some sort of yardstick.

Dick quotes figures for annual useful heat requirements based on the actual experiences obtained at Abbots Langley. He obtains a figure for the mean house temperature of different heating systems and uses this in conjunction with the useful heat needed to provide this temperature difference for houses and flats of varying standards of insulation and ventilation. He assumes a house efficiency for various heating appliances that takes into account a substantial return of heat from the flue to the house as a whole. A correction is also made for incidental heat gains due to the occupants and for solar gains during the heating period.

Table 2 shows for examples 1(*a*) to 1(*e*) in *I.G.E. Communication No.* 278, the useful heat to the house calculated on the basis of Dick's figures and also the mean house temperature rise to be expected from such a heat input in a 900 sq. ft. house of the type used at Abbot's Langley.

TABLE 2.

Specimen dwelling with three bedrooms, dining-room/kitchen, living-room (900 sq. ft. floor area).

HEATING SYSTEM.—Useful therms include an addition of 100 therms for occupational and solar heat gains.

No.	Details of Installation	Useful Therms	Calculated Mean House Temperature Rise (°F.)	Mean House Temperature Rise Quoted by Dick (°F.)
1*a*	Coke boiler, coke fire Gas sink heater for summer	534	11.2	11.5
1*b*	Coke boiler, coke fire Gas sink heater and circulator for summer	534	11.2	11.5
1*c*	Coke fire with back boiler Gas sink heater and bath heater for summer	457	9.6	9.6
1*d*	Coke fire Quick-recovery gas storage heater Flueless convector in linen cupboard	410	8.7	—
1*e*	All gas with instantaneous multi-point for water heating and a flueless convector in linen cupboard	353	7.5	—

It will be noted that there is a variation in the mean house temperatures, and these have been considered in relation to the 9.6°F. rise found by Dick to be acceptable for a home heated by an open fire with back boiler. Data are not available for the desirable temperature rise using the combinations suggested, but it seems reasonable that the temperature measured in this way need not be higher for combinations in which a more flexible form of heating is used than the open coke fire. It should be noted that the mean house temperature as the criterion must be used with considerable care, as the dominant factor in any form of heating is to provide adequate comfort in a room during occupation, and the mean house temperature does not give any more credit to heat which is directly useful to the occupant than the adventitious heat which may or may not be useful. The figure is, however, of considerable use when comparing heating systems of a similar type. The figure of 7.5°F. for 1(*e*) does, however, appear to be low for a house with full occupation, and it is considered preferable to use a value of 9.0°F. for any new calculations.

Flats.

Table 3 shows the consumptions obtained in a number of blocks of flats in which gas was widely used for space heating and for hot water services. The author is grateful to the North Thames Gas Board and the South Eastern Gas Board for providing these figures. The consumptions indicate a greater possibility of using gas for all-the-year-round space heating and hot water than was previously anticipated. Attention is drawn to the remarkable spread of consumption figures among individual flats in the same block, and to unexpected variations between the blocks of flats. These figures are clearly not comprehensive and only refer to blocks of flats in the London area where climatic conditions are much more favourable than, say, the North of England. In brackets below each figure of actual consumption is given a consumption calculated on the same basis as shown in the next section. The general tendency for calculations to over-estimate the service required is apparent. It would appear to be most important to collect a great deal more information on similar consumption figures both for flats and houses.

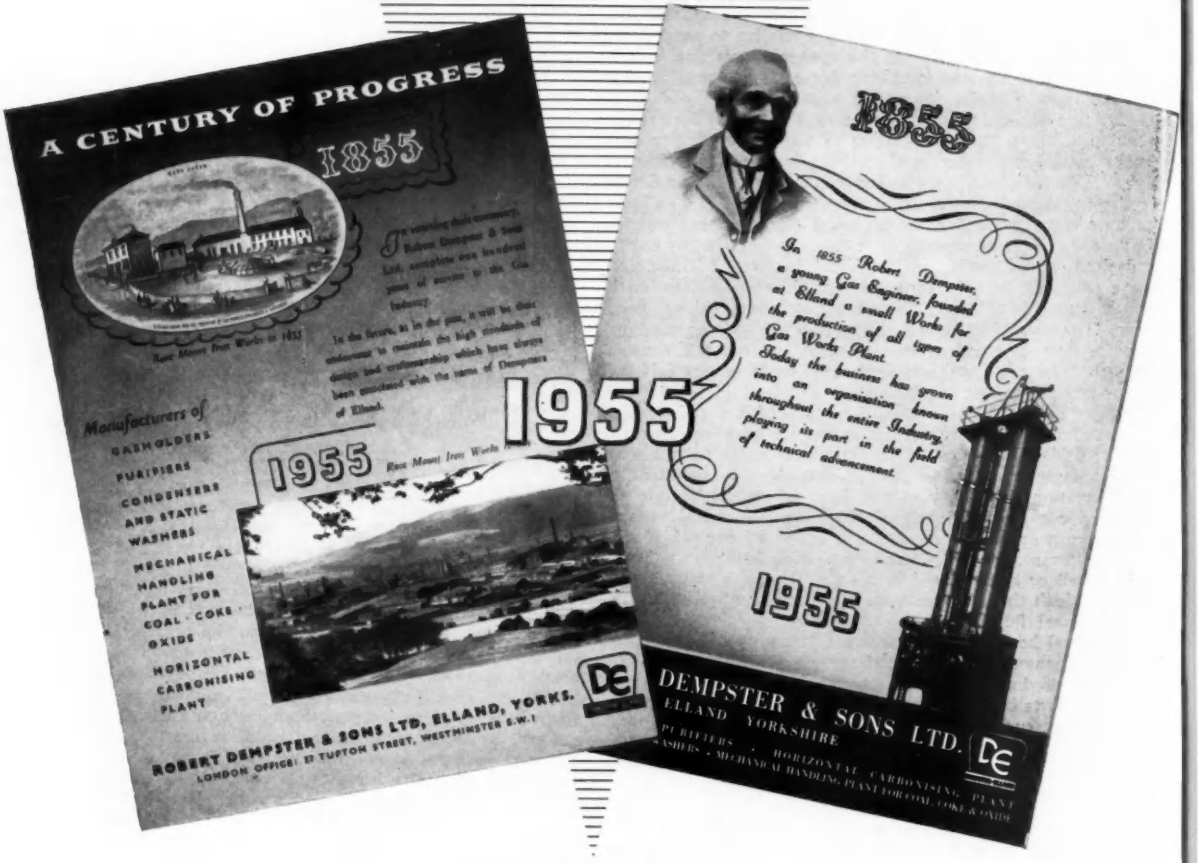
Houses Using Combinations of Gas and Coke

An estimate is made of consumptions for new combinations of gas and coke in a house of floor area 900 sq. ft. and of the construction given in detail in *Communication No.* 278—*i.e.*, a conventional semi-detached house of good construction. As a standard of comparison, the original house 1(*c*) is taken, as

* Heating Research in Homes, Weston, J. C., *J. Inst. Heat. Vent* Eng., 1949, 17 (169), 235-267.

† Domestic Heating Systems in Practice. Danter E., and Dick, J. B., Building Research Station (D.S.I.R.)

1855


A CENTURY OF PROGRESS
1855
Manufacturers of
GASHOLDERS
PURIFIERS
CONDENSERS AND STATIC WASHERS
MECHANICAL HANDLING PLANT FOR COAL · COKE · OXIDE
HORIZONTAL CARBONISING PLANT
1955
ROBERT DEMPSTER & SONS LTD, ELLAND, YORKS.
LONDON OFFICE: 57 TUFTON STREET, WESTMINSTER S.W.1
1855
In 1855 Robert Dempster, a young Gas Engineer, founded at Elland a small Works for the production of all types of Gas Works Plant.
Today the business has grown into an organisation known throughout the entire Industry, playing its part in the field of technical advancement.
1955
DEMPSTER & SONS LTD.
ELLAND YORKSHIRE

1956

Each succeeding year adds to our ever-lengthening record of service to the British gas industry.

Come what may, Dempsters of Elland face the future with a solid background of tradition, and the inspiration of progressive technical advancement.

ROBERT DEMPSTER & SONS LTD, ELLAND, YORKS.

LONDON OFFICE: 57 TUFTON STREET, WESTMINSTER S.W.1

DE
DEMPSTER · ELLAND

this represents the lowest running cost of any combination and is in line with the recommendation of the Building Research Station for the heating of low-cost houses, with the exception of their preference for some radiators from the back boiler, instead of separate heating of the dining annexe.

1(*c*) Main space heating; open coke fire and back boiler. All other space heating, including hall heating, summer hot water, cooking, laundry and refrigeration by gas, but only one convector gas fire in the main bedroom.

(A) The open fire with back boiler is replaced by an open coke fire with large back boiler that heats 30 sq. ft. of hot water radiators to provide additional heating in the bathroom and dining annexe, and also includes a flue restrictor and an integral gas fire as part of the coke fire. The other equipment is the same as 1(*c*), but includes an instantaneous multi-point for hot water. The standard of background heating is, however, higher.

(B) The main space heating is replaced by the most efficient type of free-standing convector coke fire incorporating a restricted throat. All-the-year-round hot water is provided by a low-recovery storage set with economy valve. The rest of the equipment is the same as 1(*c*).

(C) An all-gas service, including a convector gas fire of the free-standing type.

Table 4 summarizes consumptions, costs and the mean house temperature. It is of particular interest that there is so little difference in cost if a coke fire with back boiler is compared with a really efficient convector coke fire and gas for all-the-year-round hot water.

In regard to flueing arrangements it is assumed that, with

TABLE 3.—*Actual Fuel Consumption in 'All-Gas' Flats—London Area.*

Example*	Approx. Floor Area (sq. ft.)	Installation	Fuel Consumption in Therms: Average Annual †	Spread Consumption	Average Week	Average Summer Week	Average Winter Week	Calculated Peak Winter Week
1 (8)	580	Gas fire Two Balanced-flue heaters for bedroom Storage H.W. system Gas drying cabinet Gas cooker	380 (393)	286 to 419	7.3	3.0 to 6.5	9.2 to 12.2	15 to 18
2 (8)	500 to 600	Gas fire Multi-point water heater Gas cooker	276 (363)	216 to 440	5.3	3.7	7.0	10 to 12
3 (16)	500 to 580	Gas fire Multi-point water heater Gas cooker	305 (365)	150 to 580	5.9	3.5	8.3	11 to 15
4 (49)	500 to 600	Convector gas fire Electric water heater Gas cooker (in only 68% of flats)	204 (223)	100 to 300	4.0	1.2	5.4	8 to 9
5 (35)	500 to 600	Gas fire Multi-point water heater Coke grate with back boiler Cooker	246 (230)	58 to 478	4.7	3.5	5.4	6.0 to 9.0
5A (12)	500 to 600	As example 5, but electric cooker	121 (150)	62 to 188	2.3	1.0	2.6	3.0 to 4.0
6 (120)	500 to 600	Central heating by oil Topping up electric fire Multi-point water heater Sink water heater Gas cooker	187 (210)	43 to 522	3.6			
6A (8)	500 to 600	As example 6, but electric cooker	94 (130)	16 to 178	1.8			
7 (68)	500 to 600	Gas fire in bedroom Multi-point water heater Copper Gas-ignited coke fire Gas cooker	307 (238)	72 to 600	5.9	5.1	6.4	7.0 to 9.0
8 (16)	500 to 600	Convector gas fire Multi-point water heater Gas cooker	302 (363)	133 to 577	5.8	5.5	6.2	7.0
9 (16)	500 to 600	Two gas fires Central ceiling heating system Gas cooker	73 (90)	24 to 137	1.4	1.2	1.4	2.0

* The figures in brackets represent the number of flats, which is an average figure; on occasions a very few are uninhabited.
† The figures in brackets are consumptions calculated on the basis of a mean house temperature.

TABLE. 4—*Estimated Consumptions and Costs for Houses and Flats in South of England on Method due to Dick.*

Prices:—Coke 163s. 2d. a ton. Gas £5 11s. 0d. per annum and 16.8d. a therm.

Heating:—Bedroom, hall and dining annexe are heated. Gas used throughout for laundry, refrigeration and cooking.

Example	Service	Mean House Temperature Rise (°F.)	Annual Consumption: Coke (cwt.)	Annual Consumption: Gas (therms)	Cost: Annual	Cost: Average Week
	HOUSES (900 sq. ft. floor area)					
1(*c*)	Coke fire and back boiler for main living-room heating and winter hot water	9.6	40	265	£40 7s. 0d.	15.6
A	As for 1(*c*), but finned back boiler and radiators	10	43	233	£38 15s. 0d.	15.0
B	Convector coke fire and gas water heating all-the-year round ..	10	26	360	£40 15s. 0d.	15.6
C	All-gas	9	—	560	£44 16s. 0d.	17.4
	FLATS (600 sq. ft. floor area)					
D	As for B	13.5	15	330	£32 16s. 0d.	12.8
E	All-gas, as for C	12.5	—	443	£36 11s. 0d.	14.0

the exception of scheme A, one double flue which is fitted centrally is available for the living room and the dining-recess and a prefabricated flue for the main bedroom, which is vented to the roof space. The useful heat available and the estimated mean house temperature are given for each example.

Similar examples are given for flats with the exception of the solid-fuel fire with back boiler, as this is a combination that it is difficult to incorporate in many designs of flats.

It seems likely that there will be many circumstances, particularly in flats, when a more limited occupancy will wipe out the 1s. 4d. a week difference in cost between the convector coke fire and the convector gas fire.

DISCUSSION

Mr. J. E. Davis (South Eastern) said that on reading Mr. Andrew's paper and placing it alongside papers given at the recent domestic heating conference of the Institute of Fuel, he was sad to think how little progress had, in fact, been made. By this he did not mean that the paper under discussion showed no technical progress. On the contrary, it provided strong support for the views which were advanced in 1945 regarding the contribution which they could make to the betterment of domestic heating in this country.

But it also showed the sorry way in which practice lagged behind knowledge. Of the very large number of approved solid fuel appliances supplied to the home market, it would seem that less than half were either intrinsically of a more efficient type or were using the smokeless fuel which alone would enable them to give higher efficiency than their predecessors.

Mr. Andrew's paper showed how very good indeed was the service which gas and coke, and particularly gas, could give, and how economical that service could be in fuel and in money. Table 3 showed that gas can give a complete fuel service in flatted dwellings for a consumption of about 350 to 400 therms a year. This meant that the families who dwelt in a modern flat could have a modern heating installation involving no work, producing no atmospheric pollution, and requiring only some 2½ tons of coal per dwelling per annum. It showed, too, how wide a spread there was in the consumption of different families living in the same type of accommodation. The spread was very much wider than the calculated difference in cost between solid fuel and gas.

Progress Report

Mr. S. A. King (Eastern) said he had read Mr. Andrew's paper with great interest, and looked upon it as a most timely progress report on the original presented to the Institution in 1945.

While he saw opportunities for the extended use of the two fuels for whole house warming, by boiler or warm air systems, he thought by far the biggest potential lay in a solution, by way of appliance design, of what was practically a universal problem, the efficient and satisfactory warming of the living room.

Mr. Andrew had said it was doubtful if full attention had been paid to the full flexibility of a heating system in a climate as variable as ours, and with our living habits which needed an intermittent heating system. He thought there was little doubt that full attention had not been paid to this problem. He was convinced that with an appliance designed to burn at high efficiency both solid smokeless fuels, and gas in the one appliance, they would have the near perfect solution to this problem.

Mr. Andrew had reported the good work that had been done to improve the performance of solid smokeless fuel fires and gas fires, by the extension of radiant/convector principle. He further made reference in the case of solid fuel appliances to improved efficiency in performance by way of ventilation control. If further worthwhile improvements in the performance efficiency of convector gas fires were to be achieved—and this was essential for big business—it could be obtained only by some safe form of ventilation control.

Further Development

He would like to see work done on the control of ventilation of convector gas fires and on the design of a combined fuel appliance, especially for the living room, with a radiant/convector gas fire component, having controlled ventilation, and an input of the order of 15-18,000 B.Th.U. He thought such an appliance need not necessarily follow traditional design, and considerations of an independent or free standing appliance, still preserving the open solid fuel fire, should not be ignored. It might well be that in the overall interests of coal conservation, which the widespread use of such an appliance could doubtless bring about, Ministerial re-consideration of the subject of taxation could be inspired.

Mr. A. R. Bennett (Radiation Ltd.) said that, as Mr. Andrew had pointed out, the technical case for increased use of gas and coke—particularly of gas—was even more firmly established now than in 1945. This did not, however, seem to be adequately reflected in increased sales or in the acceptance by the public of gas as a fuel for domestic purposes other than cooking. During the post-war period, the industry's preoccupation with problems of manufacture and output had tended to push utilization problems into the background. During the greater part of the period in many areas other fuel industries had gained a firm foothold in fields in which, on basic merit and suitability, gas ought to be in a much stronger position.

Mr. Andrew had reviewed in broad terms the results of utilization studies carried out over the past 10 years, and had shown that the wherewithal was available to build up a sound and balanced load operated through reliable and efficient appliances. The outlines of this very attractive picture could be filled in on a substantial scale only if certain conditions were fulfilled. Two of them merited attention from a policy standpoint. First, the prestige of gas would undoubtedly be higher if greater inducements were offered to the public to replace outdated appliances. The capabilities of modern gas equipment were still unknown to a large proportion of the population. Secondly, more could be done through appropriate tariff structures to encourage the substantial use of gas as a good load factor in middle-class homes. Mr. Andrew had indicated that in very many homes the use of gas as a good load factor in fuel costs, but much more needed to be done in a propaganda sense to get this across to the public.

Mr. Andrew had suggested that attention should be directed not only to appliances for the lower income groups, but to a higher standard of heat service for those who could afford it. The country was full of people who *could* afford it, but preferred to spend their money in other directions, and it was primarily this attitude of mind towards expenditure on comfort, convenience and cleanliness that it was the task of the gas propagandist to alter.

Mr. J. B. Dick (Building Research Station) said that not only did Mr. Andrew's paper give a comprehensive survey of developments in the entire domestic field in recent years, but also indicated lines for further future developments.

Restricting his remarks to space heating, the first point concerned the question of desirable standards of heating in low-cost housing. The author had pointed out the variability of the requirements of different households but had suggested that basically what was required was really adequate provision for heating in the living room and one bedroom. He had referred to the Abbot's Langley trials in this connection, but his suggested standard was not quite in agreement with their investigations.

Survey Results

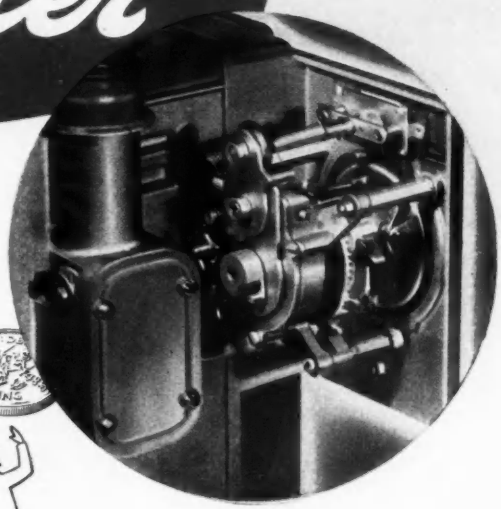
They had made a survey of current opinion on this matter. This revealed that, as one might expect, the living room was the most important, next came the kitchen—there were complaints about unheated kitchens—and finally came the bathroom. A requirement for heating in the kitchen could, of course, influence the choice of the main heating appliance in the living room; for instance, it added some weight to use of the back-boiler to provide radiator heating in the kitchen, though this could alternatively be provided, if the plan were suitable, by convected warm air. A domestic boiler would, of course, give a higher standard of heating but it involved more capital cost.

He thought the author had underestimated the house heating efficiency of the

BEGWACO

Flomaster

looks after your money



The pre-payment attachment on the Flomaster makes the theft of gas or money impossible without leaving clear evidence of wilful damage. Yet it offers easy access to collectors. Like the meter itself, the attachment is made from precision pressure die castings, ensuring very accurate operation. The mechanism is easily adjusted for variations in the price of gas. The outer case is rugged but neat. In short, the pre-payment attachment keeps up the all-round high standard attained by the Flomaster meter.

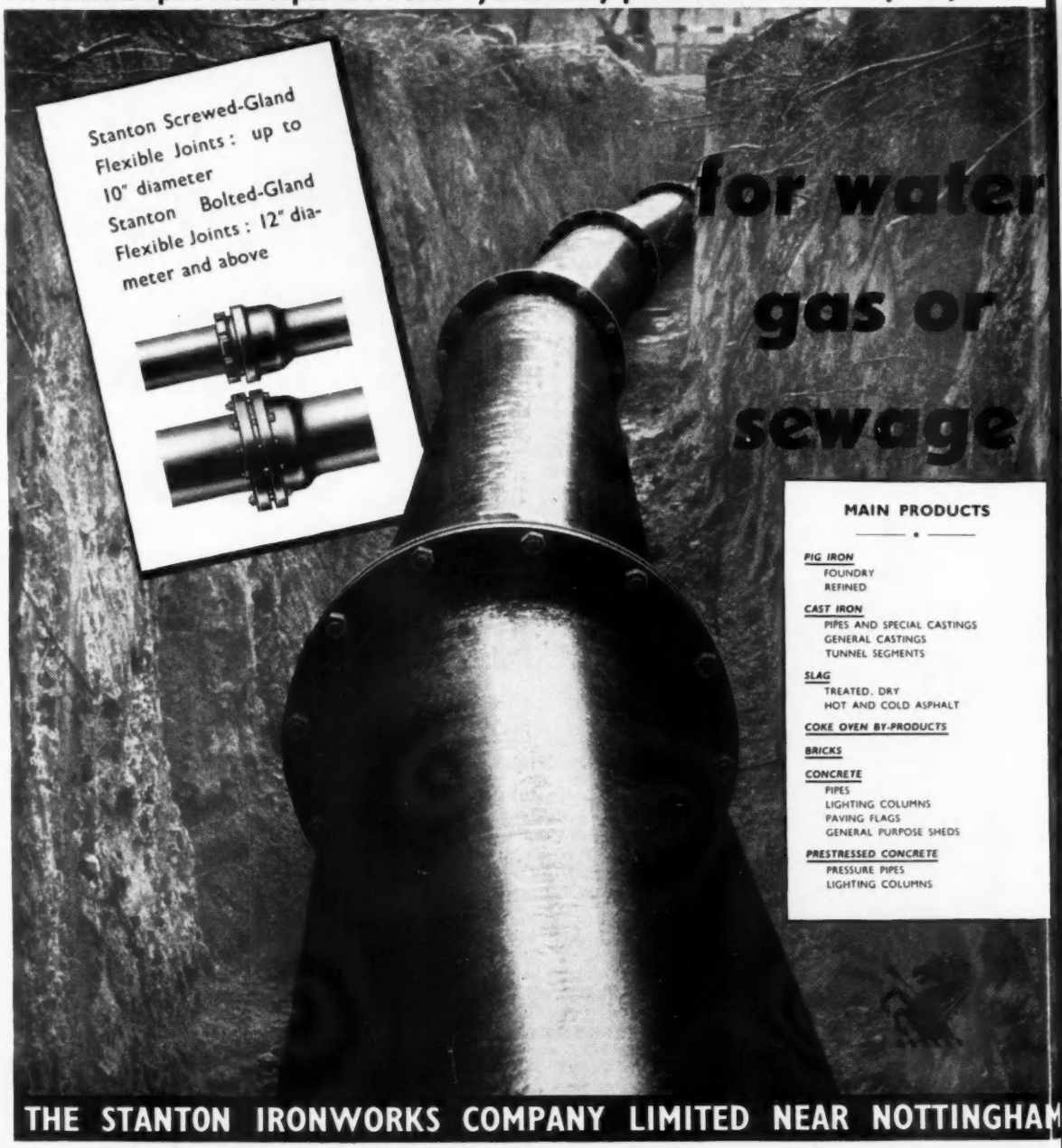
BEGWACO METERS LIMITED · QUEEN STREET · FARNWORTH · LANCS.

6M34

STANTON

SPUN IRON PIPES & FLEXIBLE JOINTS

All Stanton Spun Iron Pipes are works hydraulically proof tested to 500 lb. per square inch



THE STANTON IRONWORKS COMPANY LIMITED NEAR NOTTINGHAM

now!

PECKETT diesels

For nearly a century Pecketts have stood among the foremost builders of Industrial Locomotives. Now, after years of design development and rigorous testing, comes the Peckett diesel locomotive, robust as its steam predecessors and setting new standards in simplicity of operation and all-round economy and employing for the first time in any locomotive . . .

introducing . . .

fully automatic mechanical transmission

Developed in conjunction with Hobbs Transmission Limited, the 4-speed mechanical gear box is fully automatic—control being by throttle and reversing lever only. Acceleration and change of direction are exceptionally smooth and rapid even by current standards, and the principle of operation is such that wear in the gear box is almost negligible, reducing maintenance to a minimum.

Ask for brochure "Peckett Diesel Locomotives" which describes and illustrates general construction together with a detailed explanation of fully Automatic Mechanical Transmission.

PECKETT diesel

INDUSTRIAL LOCOMOTIVES

PECKETT AND SONS LIMITED

ATLAS LOCOMOTIVE WORKS · BRISTOL 5

Tel.: Bristol 6-55346 · 'Grams: "Peckett," Bristol

London Representatives:

Ferguson & Palmer, 9 Victoria Street, Westminster, S.W.1.

SMITH SERVICE FLOW
RECORDER METER
(manufactured under licence to Southern Gas Board)

Smith Meters *Limited, 186 Kennington Park Road, London, S.E.11*

UGI GROUP

coke fire with back boiler. In his list of assumed efficiencies this was given as 40%. Mr. Danter and the speaker had estimated that this would be obtained when coal was burned, and with coke the house heating efficiency would probably be nearer 50%. This correction made the agreement with their figures not quite as good, but he did not think it made a radical difference to the temperature comparison made in the table.

One other point was the question of estimated consumptions in flats. He was extremely interested to see Table 3, where actual gas consumptions in flats were listed and compared with estimated consumptions, using their basis for calculation. He wondered whether the author could give some further details on how this table was built up. For instance, he understood that the heat losses had been assumed to be typical of flats with medium insulation. It would be interesting to know what the effect would be if in the calculations one took the actual conduction heat loss from the plans of the various flats and then allowed for the usual ventilation rate of two air changes per hour.

One factor which would tend to give an over-estimate of consumptions was that the house heating efficiencies assumed in this section might be rather low. In flats there was further gain, heat being given off by the flues as they traversed the height of the block. The same would, of course, apply with coke or coal fires, giving higher heat efficiencies than had been assumed up to the present.

A Challenge

Mr. W. G. Phillips (Eastern) said that in the introduction to his paper, the author had stated that in the last ten years the gas industry had maintained the great bulk of domestic cooking, but the desired pattern of use for other purposes had not been achieved to anything like the desirable extent.

In saying this the author underlined one of the most important factors concerning our industry today and one which it was imperative to accept as a challenge. In an era of ever-mounting costs, particularly of coal, it was of paramount importance for us to be quite clear why we had fallen short of the pattern envisaged ten years ago. While the retention of the cooking and laundry loads, with their annual consumptions of 80 and 8 therms respectively, were vital to us they were not enough by themselves.

No doubt one of the major reasons for the downward trend in consumption per consumer was the restricted potential use for gas in post-war housing as compared with the houses which were built during the inter-war years. This restriction had been brought about mainly by two factors—the need for the strictest economy in building costs and hence in capital costs of installed equipment, and the official policy that the main space and water heating loads should be taken by solid fuel. While there was a field for gas for space heating in the home, by far the greatest potential lay in water heating and it was one of which the fringe had, so far, only been touched.

Eleven years ago, the Hayworth Report had stated that to offset any loss that the gas industry might incur in regard to the lighting and cooking load, the most favourable prospect lay in the development of intermittent water heating, a potentially substantial summer load which might in time equal the present cooking load. The additional consumption brought about by the installation of a summer water heating system can be substantial, as Mr. Andrew showed.

Balanced Flue

While the balanced flue instantaneous multipoint water heater had certainly afforded increased opportunities for providing all-the-year-round hot water by gas, it seemed that the vast majority of local authority and private development housing would continue to have installed the one solid fuel grate with back boiler for heating the living-room and providing hot water at the kitchen sink and bathroom. A small proportion of new houses built since the war appeared to use gas for summer water heating because, he submitted, of the much lower capital cost of the electrical alternative in the immersion heater and the necessity for flueing.

The author had mentioned the proposal for a combined coke fire with back boiler which included an integral gas burner to provide bulk hot water in summer. This combined appliance would seem to be one of the answers to our competitors and he would be interested to know whether the author had any information on the consumptions of the installations of the portable gas fire units, which he stated field tests had shown to be satisfactory.

Would all the labour and costs of research on and manufacture of corrosion resistant materials for water heaters be necessary if sulphur was extracted from the gas? Would not also condensing appliances be more acceptable, which would be a step nearer the author's target of a heat transfer efficiency of 90%.

The author had referred to the growing importance of improving drying facilities in houses and to the use of tumbler driers. He had said that developments were unlikely to affect the gas consumption obtained when laundry facilities were provided by gas but that they would affect the popularity of gas for drying. He would have thought the introduction of tumbler driers into this country must increase gas consumption for drying.

Dr. G. E. Foxwell said that the Beaver Committee had always visualized the extended replacement of house coal by a combination of coke and gas. The recent Domestic Heating Conference had emphasized the need for better insulation of dwellings and for local authorities to be prepared to finance better housing and better appliances in order to improve the present low standard of domestic heating and consequent waste of good fuel. If dwellings could be so built and insulated that in the conception of Broughton and Nash's paper, the 'House U' value was 0.18, or at most 0.24, the additional comfort for a given expenditure, or the lower cost for the same comfort, would be a strong incentive to adopt the more refined methods of heating. One result of that conference might be to convince the authorities that fuel efficiency, even at some additional capital cost, should be pursued in domestic no less than in industrial heating.

During the next few years most large towns and cities were likely to set up smoke control areas and in those areas most of the existing appliances would be replaced. The local authority and the Treasury between them would bear 70% of the cost. How much the authorities would spend on the displacement of present appliances to allow better appliances to be installed they did not know; but they were pessimistic. However, the Parliamentary Secretary to the Ministry of Housing and Local Government certainly indicated to the Institute of Fuel Conference that he was fully alive to the need for allowing capital expenditure to improve house insulation and domestic heating. Mr. Andrew has based his whole case for gas on the installation of the most modern appliances—appliances that were relatively costly. To get such appliances installed in smoke control areas will be the major challenge to us over the next few years.

The Beaver Committee had expected gas to take a considerable share in many of the loads that Mr. Andrew has indicated—cooking, some laundry, refrigeration, space heating in milder weather and in bedrooms, hot water during the summer in many houses and all-the-year-round in the more advanced households. A big question-mark stood over their ability to take any considerable part of the winter space heating. The magnitude of the task of replacing domestic coal by gas, which was that of multiplying the present gas industry by at least three, and taking the winter peaks at a price people could afford to pay, showed the impossibility of doing more than nibble at the huge cheese that confronted us mice.

Silence on Capital Costs

By Mr. Andrew's silence on capital costs he had omitted a very material consideration. It was fashionable to regard the cost of domestic heating as being purely a fuel cost. But there we deceived ourselves and our consumers. Repairs and maintenance and depreciation over a reasonable life were part of the cost of heating. To fit a modest house with modern gas and coke appliances would cost between £100 and £150. Did he not by this omission tilt the scale against solid fuel and in favour of gas appliances in view of their relative lives and cost? Moreover, unless everyone concerned could be persuaded to pay for the new and highly efficient appliances, must he not base his calculations on the lower efficiencies of the apparatus that we could expect to sell?

I commended to the gas industry the idea that really good service to the consumer entailed a quick appliance repair

service, with stocks of spare parts. The cost of space heating by gas was only comparable with that by solid fuel if gas was used intermittently. Under intermittent conditions, what was the efficiency of a gas fire? The author based his case on a 75% efficiency, but in the appendix he confessed that this lay in the future and that the 'present' efficiency of a convector gas fire was 60%. To that extent at least it seemed that he had over-stated his case for all-gas service by basing space heating on false premises.

A house heating efficiency of 60% or 75% simply meant that this proportion of the heat did not leave the building in the form of hot waste gas or air. But when comparing a source of continuous heat with a source of intermittent heat, one could ignore the purpose for which the heat was applied.

Coke and the Open Fire

Finally, he came to coke and the open fire. The gas industry, having been presented with a magnificent opportunity, was hesitating. At this meeting he had sensed a tendency to do whatever was possible to avoid providing coke of the quality and quantity that would be needed.

He was intrigued to see that between 1952 and 1955, 80.8% of all solid fuel domestic appliances sold in this country were open fires. The Beaver Committee estimated that 80% of the new coke must be for open fires. Let us put the *annual* sale recorded of 1,300,000 open solid fuel fires sold to 12½ mill. households against Mr. Andrew's statement that the desired pattern of use of gas for purposes other than cooking had not been achieved to anything like the desirable extent. That comparison showed clearly what the public wanted. Were we going to supply it, or should we leave it to the Coal Board? We flouted public demand at our peril.

Inquiry had shown, said Mr. Andrew, that only one coke appliance in four in London was used to burn coke, the rest used coal. Was not this a clear admission that the quality of our coke was wrong or the service we gave consumers is wrong? Was it not due also to the policy of fitting dual-fuel grates on these appliances?

The gas industry's present mood seems to be to act hard to get—'we *might* produce a bit more coke if you ask us nicely and press us hard. But of course we shall want a lot higher price for it.' He hoped someone would point out that according to the prices quoted by Mr. Andrew since 1938 the price of gas had risen 2.3 times its 1938 value, while the price of coke had risen 3.6 times; with the latest increase it was 3.8 times.

Mr. G. H. Fuidge (South Eastern) said that the author had drawn attention to the fact that the competitive position of gas had improved in relation to solid fuel since 1945, but all the figures of comparative costs given in the paper related to coke only. He was pleased to see included figures for the simple open coke fire, whereas most other authorities, particularly those associated with the solid fuel industry, compared the estimated cost of gas fires with similar costs for the most efficient modern solid fuel convector fire grate with flue restriction. There was a large number of ordinary stool bottom grates without flue restrictions still in use, and of course burning coal, and he suggested that a very good case could be made for the replacement of those grates by gas fires. Although it was realized that the efficiency of gas fires must be increased, even with the present convector fire calculations, it was possible to heat a living room at no higher cost by gas than by coal in the stool bottom grate.

One of the factors contributing to high room heating efficiency in the solid fuel convector grate was the restriction of the flue and the consequent reduction of the air flow through the room. So far, flue restriction had been used with gas fires only in exceptional circumstances, whereas experience and laboratory tests had shown that with these fires also ventilation was usually excessive. There was clearly a case for the provision of flue restrictors for gas fires particularly when installed in the standard 9 in. by 9 in. chimney.

There was room for much further development of balanced flue heaters, particularly for domestic purposes. Their efficiency was really high—75% into the room. Moreover, with these appliances the ventilation of the room could be as little or as much as the occupant required, independent of the need to remove products of combustion.

He would reinforce the author's reference to what he considered to be the most serious obstacle to the wider adoption of gas for space heating, particularly in municipal housing, and that was the cost of the peak week. Most consumers with prepayment meters had their income fully committed and they were not in a position to meet unexpectedly in cold weather an increase in expenditure on gas in a week which might be 50% or more above the normal winter week and may amount to 30s. or so.

Mr. E. Wulstan Atkins (South Eastern) said we had paid a great deal of attention to coke, and rightly so because that is one of the answers, but was it possible that we were not making our appeal strong enough on the gas side? Modern houses, modern blocks of flats, whether we liked it or not, would not use coke.

We needed the domestic market, and he suggested that if we considered the two-part tariff and the encouragement about gas production which we had been given and if we concentrated on the right appliances we should get the space heating load which we wanted. If we did not go for it we might lose more than we thought. People were thinking of central heating. If they decided on central heating for multi-storey flats, they would almost inevitably use oil, and if they used oil we should lose more than the space heating load; we should also lose the water heating load.

Mr. L. W. Andrew said that he would reply to the details of discussion in writing. The situation was urgent and vital. He believed that we were seeing the beginning of lots of space heating and water heating, as well as more cooking. The flue restrictor was a familiar subject. He agreed with most people about it. Dr. Foxwell and he were taking their coats off, turning round and putting them on again with each other fairly frequently. The suggestion, in fact, was that we still had coke but used a lot more gas, particularly in flats. For flexibility and intermittent work, then we had all gas; the story was 'More gas and a greater proportion of gas to coke.'

Seen at the Meeting

Left to right: Messrs. R. Boorn, C. C. Penfold, and S. F. Baker.

Left to right: Messrs. C. A. Poulson, C. Murdoch, and S. Varcoe.

Abstract of I.G.E. Communication 485

Production and Supplies in the S.E. Area

By R. PRINCE, M.Inst.Gas E., M.Inst.F., and J. A. GOULD, M.C., M.I.Mech.E., M.Inst.Gas E.,
Chief Engineer, and Distributing Engineer, South Eastern Gas Board.

WITH the formation of the South Eastern Gas Board, in 1949, there came under one unified control 67 manufacturing stations of widely different characteristics. They differed in the types of plant employed, the quality and composition of gas supplied and method of operation. The size of these stations varied from 50,000 cu. ft. per day in the smallest, to 35 mill. cu. ft. per day in the largest unit.

The aggregate maximum daily capacity of all stations was 250 mill. cu. ft., of which only 32% was represented by carburetted water gas, blue water gas and producer gas plants, and 68% by carbonizing plant. Of the latter, no less than 80% consisted of horizontal retorts.

(A map shown indicated the area as taken over with the new divisional boundaries added.) Of the Board's 1.36 mill. consumers, more than two-thirds were concentrated into less than one-eighth of the total area of 3,300 sq. miles; it was realized that a form of organization appropriate to the densely populated parts of the area would not necessarily be suitable in areas of scattered population. A decision had to be made as to what form of organization would best suit the new large-scale undertaking that was brought into being at vesting day and enable the Board to meet the responsibility laid upon it by Section 1(a) of the Gas Act, 1948, 'to develop and maintain an efficient, co-ordinated and economical system of gas supply for their area, and to satisfy, so far as it is economical to do so, all reasonable demands for gas within their Area.'

The Board decided that the main line of responsibility should be the functional one. Under the full development of such a system, the head of each main department would be directly responsible to the Board and have full authority throughout the area on matters coming within his function. Within each department, functional officers throughout the area would answer to the head of the department for the work of a section. The separate functions would only be brought together at headquarters under the control of the Board, production and distribution of gas up to the inlets of consumers' meters constituting one such function.

The area was divided into six divisions as follows:—

London divisions—responsible direct to headquarters	(1) METROPOLITAN:	That part of the area previously served by the South Metropolitan Gas Company.
	(2) KENT SUBURBAN:	Mainly that part of the area previously served by the South Suburban Gas Company.
	(3) EAST SURREY:	That part of the area previously served by the Croydon, East Surrey and Horley Companies.
	(4) WEST SURREY:	That part of the area previously served by the Wandsworth, Woking, Guildford and Godalming companies.
County divisions—responsible to the Board through general managers	(5) KENT COUNTY:	Mainly the undertakings in Kent, later sub-divided into the Rochester and Dover engineering divisions.
	(6) SUSSEX:	Mainly the undertaking in that part of Sussex falling within the South Eastern Gas Board's area.

Of these, the first four (London) divisions were each readily provided with office and administrative facilities, together with highly qualified technical supervision, and production and distribution of gas in each of these divisions is the responsibility of a divisional engineer responsible direct to headquarters. In the case of the two county divisions, however, the divisional engineer is responsible to his general manager, but has liaison with the chief engineer as the head of the engineering function.

The chief engineer is responsible for the manufacture and storage of gas, for products up to the point of loading for sale or treatment, and the distribution of gas up to the inlets of consumers' meters. The deputy chief engineer has special charge of the central construction department, which is responsible for planning the building of new plant, placing of contracts for major constructional projects and for supervizing their execution.

On the distribution side, a superintendent is in charge of mains and services in a certain district, and he answers to a divisional distributing engineer. The latter is responsible to the divisional engineer.

Close liaison is maintained between the 'engineering' function and those who either depend upon it or provide a service, and these are described briefly under their separate headings.

The coal and shipping manager is responsible to the Board for the purchase of coal and, in co-operation with the chief engineer, for building up and maintaining requisite stocks of coal and oil at manufacturing stations. He is also responsible for the management of the Board's fleet of 15 sea-going colliers, the transport of coal by chartered ships, and deliveries by rail, barge and road. Normal coasting colliers up to 4,000 tons cargo capacity, are employed for clearance at East Greenwich, and up to 2,800 tons capacity at Rotherhithe, but specially designed 'up-river' ships of from 1,900 to 2,800 tons cargo capacity are employed on the Wandsworth traffic. The chemical products manager is responsible for arrangements for the refining and treatment of crude tar, crude benzole, ammonia and spent oxide produced at the Board's manufacturing works. The coke manager is responsible for the sale of coke in home and export markets, either directly to consumers or through agents and merchants, and for rendering accounts for coke supplied. Broadly, the Engineering Department accepts responsibility for the production and preparation of coke and its loading into ships, railway wagons or lorries, but the Coke Department is responsible for the disposal of the quantity available to it.

Policy and its execution is formally co-ordinated through a management committee on which the Chairman, Deputy Chairman and part-time members of the Board sit with chief officers. To this committee, appropriate chief officers submit monthly reports, seek approval for any major schemes and obtain guidance on policy.

No doubt, in common with other gas boards, the South Eastern Gas Board at vesting date was faced with two major problems:—

(*a*) Many gasmaking plants were considerably run down during the war years when necessary repairs and replacements could not be made, and, if failure to supply were to be avoided, the making good of deficiencies was a first priority.

(*b*) Circumstances similar to those obtaining on the works prevailed within the distribution network. There had been major movements of population and the development of mains systems had necessarily lagged behind these movements.

Coal gas can be produced at the lowest cost at major riverside stations, owing to the cheap water transport facilities. The existing riverside and coastal works able to accept direct supplies of seaborne coal were surveyed in the light of being strategically placed for the economic distribution of gas and coke which might be manufactured there and for their potential production capacity. At the present time, some 3.75 mill. tons of coal are carbonized annually, of which, under normal conditions, 87% is drawn from the Durham and Northern divisions of the National Coal Board, some 10% from the North Eastern (Yorkshire) division, and 3% from the South Eastern (Kent) division.

Of the total coal requirements, some 60% is dealt with direct by the Board, the majority being carried by the Board's own fleet of colliers, which comprises vessels of the former South Metropolitan and the Wandsworth Gas Companies, with the addition of ships built for the Board. The balance of tonnage is handled through a small number of specialized distributors. The colliers discharge at the Board's own berths at East Greenwich, Rotherhithe and Wandsworth, which, in the order named, can deal with approximately 960,000, 460,000 and 760,000 tons per annum. The East Greenwich and Rotherhithe jetties, in addition to serving those manufacturing stations' own requirements, accept coal for subsequent transport to the Vauxhall and Croydon gasworks, and all coal required for the six works within the West Surrey division, in addition to the Wandsworth works' own needs, is discharged at the Wandsworth jetty. The Brighton works (at Portslade) has facilities for the discharge of coal from ships direct to the retort house and to storage grounds. Seaborne coal is delivered *via* Dover Harbour and thence by a short rail haul to the Dover works, and alternative supplies of Chislet coal are enrailed direct from the colliery.

The choice of carbonizing plant employed at each station has been and will be dictated by a diversity of influences, namely, the type of available coal to be carbonized, the characteristics of coke required for given markets and the siting of the particular plant in relation to the surrounding neighbourhood. The forward planning is tentative and should be regarded as but one of several possible extensions of development depending upon the growth in gas demand and the economics of gas production as they may be influenced at that time by the relative costs of coal, coke and oil. It is possible that future policy may dictate further integration and a corresponding reduction in the number of manufacturing units shown.

Ratio of Carbonizing/Gasification Plant

An over-riding principle accepted by the Board in the development of the 'selected' station has been that carbonizing plant should be provided to meet base-load requirements only and should not be used to meet the diversity between summer and winter output. The base-load coal gas should be diluted to the standard calorific value by the addition of producer gas or blue water gas, according to the demand for and value of coke; all gas requirements above this base load should be taken by carburetted water gas at 500 B.Th.U. per cu.ft. Such a procedure will allow for the efficient use of heavy oil over the major portion of the year, as and when plants are so adapted, reserving gas oil for periods when maximum production is called for.

Thus the conclusion has been reached that the manufacturing capacity at all integrated works should be in the approximate ratio of 50% of carbonizing and 50% of 'gasification' plant in the form of either producer gas, water gas or oil gas plant. It is estimated that the annual load factors of the carbonizing plant and the 'gasification' plant installed in that ratio will be approximately 90% and 45% respectively, each major station being expected, so far as possible, to take its true share of the diversity in load, thus giving a gas of comparable quality throughout the integrated system.

In estimating the total capacity of manufacturing plant required, a factor of 1.65 times the mean day is taken and, allowing for the flexibility of storage capacity, this has proved to be adequate. The development of the East Greenwich Works with a capacity of 36 mill. cu.ft. per day at vesting day has been increased to 72 mill. cu.ft. per day. Plant under construction will increase the capacity to 81 mill. cu.ft., with further provision up to 102 mill. cu.ft. per day.

The other selected works to contribute to the manufacture of gas for the area are the Rotherhithe works, with a capacity of 25 mill. cu.ft. per day, which will not be increased in size in spite of its seaborne coal handling capacity, Croydon, with a capacity of 30 mill. cu.ft. a day, Wandsworth with 32.5 mill. cu.ft., Dover with a present capacity of 2 mill. to be immediately increased to 14.3 mill., and Brighton (Portslade), which has been developed to a capacity of 4 mill. cu.ft. a day.

Of future developments in manufacturing capacity the most important are, a gasification plant at Wandsworth of 4 mill. cu.ft. per day, and a possible future development to 60 mill. cu.ft. per day, a further projected extension at Dover of 7.5 mill. cu.ft. per day.

Perhaps the most outstanding development scheme for gas manufacturing capacity is the Isle of Grain project. An agreement has been come to with the British Petroleum Company, Ltd., for the leasing of a site on their works at the Isle of Grain for the building of a Segas oil gasification plant. The plant now being built has a capacity of 14.20 mill. cu.ft. per day, but the site is capable of development to 80 mill. cu.ft. per day.

In a fully integrated system of gas supply, the production potential, pumping capacity and gasholder storage are quantitatively inter-related. The experience of the South Eastern Board in the London divisions confirms that storage capacity equivalent to 11 hour supply on the maximum day is adequate for local distribution, and that for bulk transmission the equivalent of 4 hours at maximum rate of transfer should be made available at the point of dispatch.

Common C.V. Needed

Inter-linked gas supplies call for a common calorific value and range of gas quality if gas is to be exchanged freely between manufacturing stations. The range of gas qualities also determines the type of plant to be installed. Early in 1949 a decision was reached that (i) the declared calorific value throughout the area should eventually be 500 B.Th.U. per cu.ft., and (ii) that the limits of specific gravity should be 0.42 to 0.51, corresponding to a Wobbe Index ranging from 770 to 700. This enables gas appliances, where desired, to be supplied with fixed injectors, adjusted in the appliance workshops to a mean value, and that, with governed pressure, the thermal input to an appliance does not vary more than 5% from the mean.

Concurrently with the selection of major gasmaking stations and the concentration of gas manufacture, it was necessary to plan and assess the cost of the bulk transfer of gas from those centres of production to the areas of distribution by a system of inter-linking transmission mains. It should be noted that in general all capacities are based upon the principle of gas transfer at constant rate throughout the 24 hours in order to reduce to a minimum the capital outlay both on mains and pumping plant and the operational cost of pumping.

A production control office was established in the chief engineer's department at headquarters in 1949, to which each division reports twice daily its make, stock and output of gas, atmospheric temperature records and other data covering operational control. This production control office is staffed 24 hours daily in order to assist operational control by the full employment of the most efficient plants and the transfer from them of any surplus gas to stations that are unable to compete in cost, but the normal day-to-day and hourly control within each division rests with the divisional staffs. This office provides a convenient focal point to which all emergencies that may occur in any part of the area can be reported readily, thus enabling the responsible officers concerned to take immediate and appropriate action.

As a result of the interplay of the changed level of material prices, of wage rates, of gas output and the changed pattern of manufacture it is difficult to avoid quoting costs of production over a period of years, from which misleading conclusions may be drawn. It may, however, be of interest to point out that as several new large units of plant were not brought into production until 1954-55, and the South London transmission main, which integrates the Board's major manufacturing stations, was not used until October, 1955, the benefits of this plan of production and supplies are only now beginning to be reflected in over-all operational costs.

The calculated 1951-52 price changes would have increased the cost of gas as compared with 1950-51 by 0.57d. plus 0.7d.

a total of 0.84d. per therm, but the actual increase was 0.57d., due to the fact that 0.27d. was contained by a change in manufacturing practice, in this case largely due to the use of a higher proportion of gas oil to coal. Again, by 1954-55 the cumulative effect of price changes had reached 2d. plus 0.61d., a total of 2.61d. per therm. By this time, however, the introduction of new manufacturing plant lowered operating costs, with the result that 0.61d. was contained and the net cost increased by 2d. per therm.

The provision of transmission pipelines involves a considerable proportion of the capital expenditure related to integration schemes. Their planning and routing involve a great deal of investigation, and the assembling, laying and jointing of the pipes and their accessories involve considerable labour and manipulative skill. The fact that the mains are buried and therefore difficult and costly to expose for repairs and replacement makes it imperative that the work of laying and testing them must be thoroughly and conscientiously executed and supervised. Some details of the various transmission schemes in the area follow. It will be seen that there are two main integration systems, which link numbers of major manufacturing stations, namely, the transmission main linking the London Divisions (known as the South London Main), and the Isle of Grain transmission scheme. These two grids provide for gas to be pumped in either direction.

The South London Main

The transmission main linking the London Divisions links East Greenwich works with the Sydenham works, Waddon works and the Carshalton, Sutton and Worcester Park holder stations.

The general arrangement provides that normally gas will be pumped from East Greenwich to Sydenham and then re-pumped from Sydenham through the South London main westwards, but the connections at Sydenham make provision for the compressors to be installed there to be by-passed so that gas can be pumped straight through from East Greenwich to Croydon, Sutton and Worcester Park. The main was used in this way during the winter of 1955-56. At Sydenham, Waddon and Worcester Park, connections to the South London main are provided so as to enable gas to be pumped back in the reverse direction should this be necessary for emergency purposes.

The scheme, as originally conceived, provided for 24 mill. cu.ft. of gas per maximum day to be transmitted from East Greenwich to Sydenham, the whole quantity being re-pumped at Sydenham to the East Surrey and West Surrey divisions.

The cost of distributing gas through the South London Main varies from 0.596d. per therm through to the Carshalton holder station to 0.763d. per therm through to the Worcester Park holder station.

Reference has also been made to the decision taken to provide compressing plant at Sydenham capable of pumping at the rate of 1.5 mill. cu.ft. per hour. This was based on revised estimates of the maximum daily quantities of gas to be taken at the receiving points. The gas supplied to the various receiving points will be regulated by volumetric governors and measured by inferential meters. It is necessary for each division to control the rate of take at its various volumetric stations. At the same time, East Greenwich works requires to know the total rate of take in each division. To secure economical operation of the boosting plant, it is necessary for the terminal pressure at Worcester Park to be remotely indicated at Sydenham, and the terminal pressure of the gas at Sydenham to be remotely indicated at East Greenwich. Apart from these requirements, the control apparatus has to provide for the indication of holder stocks and volumetric governor inlet pressures; also to record outlet pressures. The Elliott-Bristol system of remote control was decided upon, employing the Bristol 'Metameter' transmitter which uses audiofrequency impulses for the transmission of signals. The recording instruments are made by Elliott's, as are the inferential ring-balance-type meters.

There are two 48-in. mains leaving East Greenwich works, which were laid by the former South Metropolitan Gas Company, and they will be capable of transmitting the gas to holder stations at Old Kent Road and Kennington and district governor stations throughout the divisional district. One of these, known as the 'A' main, will eventually convey the whole of the gas required at Old Kent Road and Kennington and the district governor at Blackhorse Bridge, Deptford, *en route*, involving a maximum pumping rate of 1.9 mill. cu.ft. per hour with an initial pressure at East Greenwich of 35 in. W.G. This production load will all be pumped direct to Old Kent Road, but the gas required at Kennington holder station, which at present receives a major part of its supplies from Vauxhall Works, will, when Vauxhall works is closed down, be re-pumped at Old Kent Road at the rate of 845,000 cu.ft. per hour, and at an initial pressure of 102 in. W.G. The gas-making capacity of Rotherhithe Works is greater than the district demand, and surplus gas from Rotherhithe will also be pumped to Old Kent Road for distribution elsewhere in the division.

There were four manufacturing stations within the East Surrey division at vesting date, namely, Croydon, Redhill, Horley and Dorking. As is stated later, Redhill, Horley and Dorking were planned to be shut down by the laying of the Crawley main, thus leaving the East Surrey division with the one works at Croydon. Further, the Horsham works in the Board's Sussex division was also to receive a bulk supply from the East Surrey division, *via* the Crawley main, enabling manufacture to cease. Although the Bromley and Dartford works have been closed down in the Kent Suburban Division since vesting day, no main laying has been necessary as the transmission systems are adequate, but future expansion in demand will be met from the Isle of Grain grid. In the East Surrey division, Croydon will be the only works to remain as a manufacturing station. All other gas in this division will be drawn from the Crawley main. This main will also make possible the closing down of manufacturing stations at Horsham and Kingswood. The daily demand from the East Surrey Division, the West Surrey Division at Kingwood, and the Sussex Division at Horsham on the Crawley Main will be about 11 mill. cu.ft. a day.

Integration in the West Surrey Division has been centred on Worcester Park and later Kingston. Worcester Park began to be developed as long ago as 1932, by the laying of a main from Wandsworth and an 18-in. main on to Epsom. The original idea was to make Worcester Park into a kind of extended storage plant for Wandsworth. In 1941 Worcester Park was responsible for Sutton, Kingston, Esher, Cobham and Byfleet districts.

As the load on Worcester Park increased, it was decided to build a similar distributing centre at Kingston and not to develop Worcester Park any further. This was done by laying a 24-in. main from Kingston to Esher. To enable supplies to be extended, a 24-in. main will be extended from Esher to Guildford and all gas supplies to this part of Surrey will be pumped from Kingston, enabling the manufacturing stations at Godalming, Cranleigh and later Guildford to be shut down. This will apply to Walton and Woking also. The distributing centre at Kingston will be strengthened to accomplish this and a 17 mill. cu.ft. per day at 10 lb. per sq. in. will be the final demand on this centre.

Stations to Close Down

The integration of the Sussex Division is based on the manufacturing stations at Brighton (Portslade) and Glyne Gap works at Hastings. From Brighton, mains have been laid to Newhaven and Seaford, Lewes and Uckfield, Hassocks, Burgess Hill and Haywards Heath, Steyning, Storrington, Billingshurst and Petworth. This integration will enable all the manufacturing stations involved to be closed down. The Brighton Black Rock station has now been replaced by the new works at Portslade which is supplied by seaborne coal.

To supply gas by 10-in. main to Newhaven, it was necessary to cross the river Ouse, by laying the main across an existing swing bridge. For this to be successful, isolating valves are provided at each end of the bridge and means for breaking the joints enable the bridge to be swung open when needed for shipping passing up or down the river.

From Glyne Gap works at Hastings a 6-in. main has been laid as far as Pett and a 4-in. main from Pett to Rye. This has made possible the scrapping of two small holders at Pett and one at Winchelsea as well as closing down the works at Rye.

The integration in the Rochester Division is based on the Rochester-Gillingham ring main system which had been laid before vesting date by the former South Eastern Gas Corporation. This will be later reinforced by the 30-in. main from the Isle of Grain gasification plant. It is planned that all gas-

This smart modern kitchen features two of the latest Flavel appliances—the 'Mercury' cooker and the streamlined 'National' Gas Water Heater.

Head and shoulders above the rest in VALUE!

THE FLAVEL MERCURY

The full-size, bow-front quality cooker that always makes friends with the housewife

HERE's a big, well-built, handsome-looking cooker you can recommend with your hand on your heart. The Flavel Mercury gives your limited-purse customers (1) Four new-type fast-boiling burners (2) new enamelled non-spill pan rests (3) an extra-large oven with the new Flavel light-reflecting 'Ice-Blue' finish (4) push-turn safety taps in a choice of ivory, red, blue, burgundy, brown or black—at no extra cost. And show your customers all these other major selling points... Burners of latest die-cast head type; grill has light-across jet; pan rests enamelled top and bottom for easy cleaning; Mercury supplied in choice of white, ivory or fawn clean-at-a-wipe vitreous enamel finish (same price).

The Flavel 'National' water heater (shown above) gives half-a-gallon of piping hot water every minute . . . very economically.

★ *Frequent, big-space advertising in the National Press is helping you sell the whole range of big-value Flavel appliances.*

15 Million Housewives will be told 'See a FLAVEL FIRST!'

SIDNEY FLAVEL AND CO. LIMITED, LEAMINGTON SPA. TELEPHONES: (SALES) 3091 AND 8700. TELEGRAMS: FLAVELS

works in this area should be closed down, but it is unlikely that this will be complete before 1960. By that date extra gas would be available to supply Maidstone from Rochester and not to reinforce Rochester from Maidstone as is being done at the moment.

In the Dover Division a scheme is being carried out for the complete integration of the area based on the new extensions at the Dover works. This involves the closing of all manufacturing stations in the Division except Dover and Canterbury. A new 18-in. main is being laid north-west from Dover with 8-in. branches to Sandwich and Deal; a 15-in. branch supplies the Ashford and Faversham districts; an 18-in. branch supplies the Isle of Thanet; and finally, reduced to 12 in., the main proceeds via Canterbury to supply Whitstable and Herne Bay.

Isle of Grain Transmission Scheme

The Isle of Grain is to supply the majority of North-East Kent, including Rochester and Maidstone and as far south as Tunbridge Wells, with a connection through to the South London Main at Sydenham works. It is anticipated that the plant will be finally developed in three stages to a capacity of 60 mill. cu.ft. per day, of which 40 mill. cu.ft. will be utilized in North-East Kent and the balance of 20 mill. cu.ft. will pass forward into the London main.

The anticipated detailed distribution of the 60 mill. cu.ft. per day is as follows: Kent Suburban Division 12.16 mill. cu.ft. per day, Rochester Division 21.84 mill. cu.ft. per day, St. Mary Cray 5.42 mill. cu.ft. per day and 20.00 mill. cu.ft. will pass into the South London Main at Sydenham.

For design purposes, the grid was divided into two sections, section 1 being the main from Grain to Rochester (the first offtake point), and, section 2 being from Rochester to London, with all the resulting side connections.

Dealing with section 2 first, it was provisionally decided, in view of the large quantities of gas that were to be handled, to lay a 36-in. main from Rochester to the 'Black Prince' public house, south of Crayford. This decision was taken having regard to the initial pressure that would be necessary, and was confirmed by the subsequent calculations made of the overall cost per therm of the gas to be delivered to the various stations that were to be supplied. These calculations revealed that the overall average cost per therm in distributing the gas to all stations was 1.07d. The lowest cost per therm was 0.5d., into Rochester, and the highest was 1.7d. for gas into Sevenoaks. The size of the branch mains laid from the 36-in. main to supply the various stations was determined by the quantities of gas to be supplied to those stations, and the pressure available in the 36-in. main. When making the flow calculations, the dictating pressure was that at St. Mary Cray where the terminal pressure was taken as 7 lb. per sq. in., and this pressure gave terminal pressures at all other receiving stations of approximately 1 to 2 lb. per sq. in. and a pressure at the Rochester branch of 12.5 lb. per sq. in. It will be noted that the mains to St. Mary Cray and to Snodland are both 30 in. diameter, due to the large volume of gas to be transmitted *via* these two mains. St. Mary Cray will ultimately be receiving at the rate of nearly 1.25 mill. cu.ft. per hour, and Snodland 750,000 cu.ft. per hour.

It was considered to be uneconomic to pump the gas direct to London or direct to Maidstone, Sevenoaks, Tonbridge and Tunbridge Wells, and re-pumping is to take place at St. Mary Cray and Snodland.

An 18-in. dia. main exists between St. Mary Cray and Sydenham and in the early stages it will be possible to pump direct from St. Mary Cray to Sydenham, and, as the load increases, further re-pumping will be necessary at Bromley; finally, with 20 mill. cu.ft. of gas passing into Sydenham works, it may be necessary to increase the diameter of the main between St. Mary Cray and Bromley. This last step is contemplated due to the fact that the existing main is lead-jointed, and, although the joints are clamped, it is not intended to work the main at a pressure higher than 15 lb. per sq. in.

Calculating B.H.P.

As already mentioned, the pressure required at the Rochester branch to transmit the gas towards London and Snodland was 12.5 lb. per sq. in., and this pressure was, of course, the terminal pressure used in calculating the initial pressures necessary at Grain. From these pressures the brake horse power required at the compressor was determined and hence the pumping cost in pence per therm.

It was found that during the first stage of the scheme when 17.96 mill. cu.ft. per day will be transmitted from the Isle of Grain a single 24-in. or 30-in. main would be the most economical and as the load increases, the diameter of the most economical main also increases, therefore in reaching a decision, the question of the greater margin of safety that would result if twin mains were laid was carefully considered and finally it was agreed to lay one 30-in. main in the first instance and to lay a second parallel 30-in. main when the load has increased. In order to avoid difficulties in the future when laying the second main the easements for the first main are being negotiated to make provision for the second main to be laid.

DISCUSSION

Mr. G. le B. Diamond, Chairman of the West Midlands Gas Board, was of the opinion that those who drafted the Gas Bill and planned the organization and structure of the nationalised gas industry built better than they knew. The autonomous area board was a master stroke and had enabled each board to set up its own organization which was best suited to its needs. The local circumstances in the South East were totally different, for example, from those to be found in Wales or in the Midlands.

The plain statement that the South Eastern board, when constituted, became the employer of 22,000 people directed attention to the comparison of the number of employees taken over as between one board and another. In the West Midlands Area, with a larger output of gas and approximately the same number of manufacturing stations, the total number, including part-time workers, taken over on vesting date was 11,918. This remarkable disparity did not indicate a higher productivity per employee. On the contrary, the paucity in the number of employees in the West Midlands had been, and was, a feature of the immense demand for labour in the Midlands, coupled with the fact that the local authority undertakings, comprising the greater number taken over, were not self-sufficient like the company undertakings, for often the Town Clerk and the Borough Treasurer performed essential functions which in a company undertaking were provided by their own employees. Moreover, the South Eastern Board possessed an extensive coal and shipping department and had a preponderance of horizontal retorts.

A Certain Discretion

He was particularly interested in the organization set up by the board to administer the area. He favoured the line and staff organization with a specialist headquarters' staff giving advice to the specialist divisional staff and leaving the latter a certain discretion in the implementation of board policy, with the proviso that if any of the officers at district level disagreed with, or did not accept a specialist officer's recommendations, they were under strict oblication to communicate immediately with him personally, or the Deputy Chairman. A contented and happy staff was vital for the successful operation of an area board and he did not believe this could be obtained without a fair measure of decentralization and the delegation of a measure of local responsibility.

No amount of high-powered training courses could create managers from individuals who had spent sheltered lives in specialist occupations. The only place to train managers was in the exercise of the art by delegation of minor management functions at the local level.

In the South East the selection of manufacturing stations, and the integration that had been carried out since vesting day, followed a plan which had been almost naturally imposed by geography but the Board and its officers were to be highly commended for the skill with which they had carried it out and the speed with which they had been able to close down the small and medium-sized uneconomic works.

From time to time over a long period of years a number of people had suggested and examined the possibility of building a large coke oven installation somewhere down in East Kent for supplying the whole of the metropolitan area. Even Ritchie, in his book on the

Evolution and Development of the Kent Coalfield as early as 1919, had speculated on this possible development.

Unfortunately, the Kent coalfield had proved to be a very expensive field to work. This might not always be so. Moreover, with the ultimate exhaustion of the Durham coalfield it would seem that the South East of England and the metropolis would have to make far more use of this considerable deposit of coal than had hitherto been contemplated.

He would like to ask finally what had happened to the South Eastern project for Lurgi high pressure gasification that had had such promise some few years ago. The West Midlands Lurgi project had been bogged down in interminable planning difficulties for the last five years. There was no one in the gas industry who wanted to spoil the English countryside, but the current planning procedure involved going through all the motions and all the loss of time before it could be found out whether it was possible to put a plant in a specific place, and it was impossible to get any help from the authorities as to where it could be put.

Change in Manufacturing Practice

Mr. F. Bell said the financial aspect of gas production and distribution given in Fig. 5 and Table 9 was most helpful, but he would like to know if the authors would care to suggest what proportion of the cumulative reduction in the costs achieved by the change in manufacturing practice, especially the 1956/57 figures, was due entirely to changes in manufacturing technique and to those changes which had been made possible by the introduction of the South London transmission main.

With an integrated system of this size a central control office was essential for the monitoring of gas movement within the area, and he was interested to note that to secure economical operation of the boosting plant, a system of remote control with the 'Metameter transmitter equipment was to be installed.

The maintenance or replacement of the mains system of an integration scheme of this type was difficult and costly, and it was for this reason underground work must be of the highest possible standard. The application of the methods of testing mains systems, as detailed in the Chairman's Technical Committee Report 1949/50, had materially helped in this direction. In a similar manner, the recommendations of the Pipes Committee for the internal protection of steel pipes with red lead paint, as noted by the authors on page 32, still further prolonged the life and reduces the maintenance of such underground systems. It was surprising that this particular recommendation was not more widely implemented.

The authors indicated that the distributing costs throughout the system ranged between 0.5d. and 1.7d. per therm, which were remarkably low figures and must have been achieved by careful design and planning in conjunction with a high load density applicable in this particular area.

The paper would be most helpful to anyone considering new integration schemes, or even extending existing ones, and the many special projects which had been so carefully described would be a most helpful guide to engineers considering similar work.

Dr. J. Burns (Chief Engineer, North Thames Gas Board) said the South Eastern Gas Board should be congratulated on building up such an efficient organization. It was a form of organization particularly suited to the 'countryside' in South London, and the form of organization which had been built up had some similarities at least to the organization which existed in the Gas, Light and Coke Company.

This type of organization had great advantages for its particular area. It might not be so good in other areas because the geographical conditions differed in every area. It provided a devolution of responsibility down the line which led to each individual knowing quite clearly what he had to do; it also ensured a great degree of loyalty.

It also resulted in the accumulation of responsibility at the top, and it was worth while examining the type of man who should be selected to fill the post of looking after a large works. He should be certainly a technologist and have had the opportunity of working in the works which he supervised to enable him to appreciate the problems associated with labour and get that indefinable sense of the workers' problems.

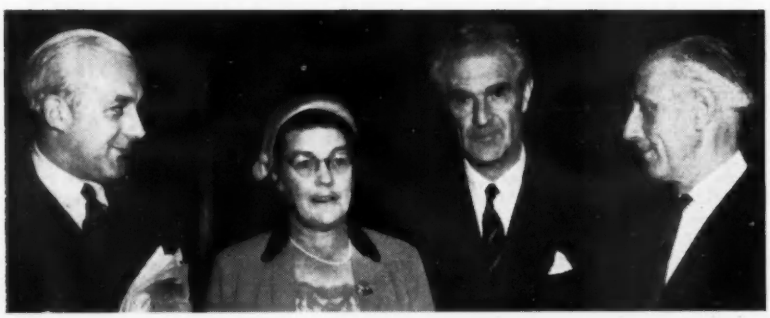
Regarding the type of plant chosen, an interesting relationship had been developed between the average and the mean day of the year and the mean load requirement, the factor of 1.65 times the mean day being taken. Taking the conditions which had occurred in the area of the North Thames Gas Board last year, with the temperature down to −21°F., that factor would not be 1.65 but 1.80. Calculating the difference between those two factors in terms of the plant required to meet the load at that time it represented 35 mill. cu.ft. per day, which constituted considerable difficulty, and compelled specialization in forms of gas manufacture requiring only the minimum amount of labour.

Mr. W. T. Hird said that the paper teemed with interest, and the authors were to be congratulated on the lucid way they dealt with the complex network of the distribution system.

The effect of the capital expenditure and the result of economies on production costs showed a trend which must give the authors much satisfaction, but he would like to know whether the net cost into holder shown year by year included the cost of transmission. The cost of pumping gas in this complex system shown separately would be a most interesting figure.

The Isle of Grain Scheme was clearly a project of the utmost importance and was, no doubt, only the first example of a most significant development. With the ever increasing cost of coal the production of equivalent coal gas from the out of balance products of oil refineries must be of increasing interest to the gas industry—and to the oil industry. The brief account given in the paper must whet the appetite of all gas engineers for more information as soon as this became possible. The details given of the calculations which led to the choice of pipeline for transmission of the Isle of Grain gas showed how logical had been the decision to lay 1-30 in. main now and a second main as the load grew.

An R. & J. Dempster group: Messrs. L. J. Walker, G. Lefevre, R. Pollard, C. H. Davidson, and W. W. Scott.



Left to right: Mr. G. J. B. Cox, Mrs. Stanley Bennet, Mr. D. D. Burns, and Mr. Bennet.

Abstract of I.G.E. Communication 487

Consideration and Assessment of Coke Dry Cooling

By A. E. MORRIS, B.Sc., A.R.T.C., M.Inst.Gas E., M.I.Chem.E., M.I.Min.E.,

Executive Director, C.O.L. Division, West's Gas Improvement Co., Ltd.

THE basic complaint against wet quenching is that the steam automatically takes the blame for effects for which it is not, or at least only in small part, responsible. There are in carbonizing plants other causes for corrosion and dust deposition. Nevertheless, the fact remains that some 25% of the heat used for carbonizing in static plants is discharged from the plant as sensible heat in the coke, which in wet quenching systems is dissipated in the useless evaporation of approximately ½ ton of water per ton of coke cooled. If this heat can be usefully employed, the gain is obvious, and the attainment of this is the fundamental function of coke dry cooling. Hitherto, there has been a natural reluctance to install a plant, the economic advantages of which up till recently have not been attractive; but now the national fuel economy demands the elimination of waste of utilizable heat. The value of this sensible heat has increased relative to other values.

Two main systems have been developed to carry this out:—

(1) The transference of the hot coke from the carbonizing unit to a separate and independent vessel, and the circulation through the hot coke of a cooling gas, which must, of course, be essentially oxygen-free. The heated gas is passed through a boiler for the purpose of raising steam. Alternatively, the sensible heat of the coke may be used for preheating a low calorific value gas (*e.g.*—producer gas), which can then be used as a fuel gas for the carbonizing plant.

(2) The discharge of the hot coke from the carbonizing unit into a cooling chamber which forms an integral part of the carbonizing unit structure, and the passage of steam through the hot coke in the cooling chamber. The mixture of superheated steam and water gas passes straight into the recharged carbonizing section of the unit, where further water gas formation takes place, all the resultant products then mixing with the distillation gases.

Except for one case, in all the plants built so far the circulating gases used as the coolant, consist of a mixture of nitrogen and carbon dioxide and pass through a steam-raising installation after absorbing heat from the coke. The cooled gases are returned to the coke-cooling unit or units. The two known systems in accordance with which installations have been built are the Collin and Sulzer systems.

The Collin System

The outstanding characteristic of the Collin system is discharge of hot coke from carbonizing plant direct to cooling chamber, *i.e.*,—there is no transportation of hot coke. This system is not suitable for horizontal retort installations, but lends itself admirably for intermittent vertical chamber and coke oven plants. In the standard type of Collin plant slow cooling of the coke is effected by passing an inert gas through the body of the coke, which lies stationary on an inclined grate, in a refractory-lined chamber. The gas is heated by the sensible heat yielded from the coke and passes on to a waste-heat boiler system, where the heat is given up, first to a superheater, then to a fire-tube boiler, and finally to a feed water heater. After passing through the feed water heater the cooled gases are returned to the cooling plant by means of a fan.

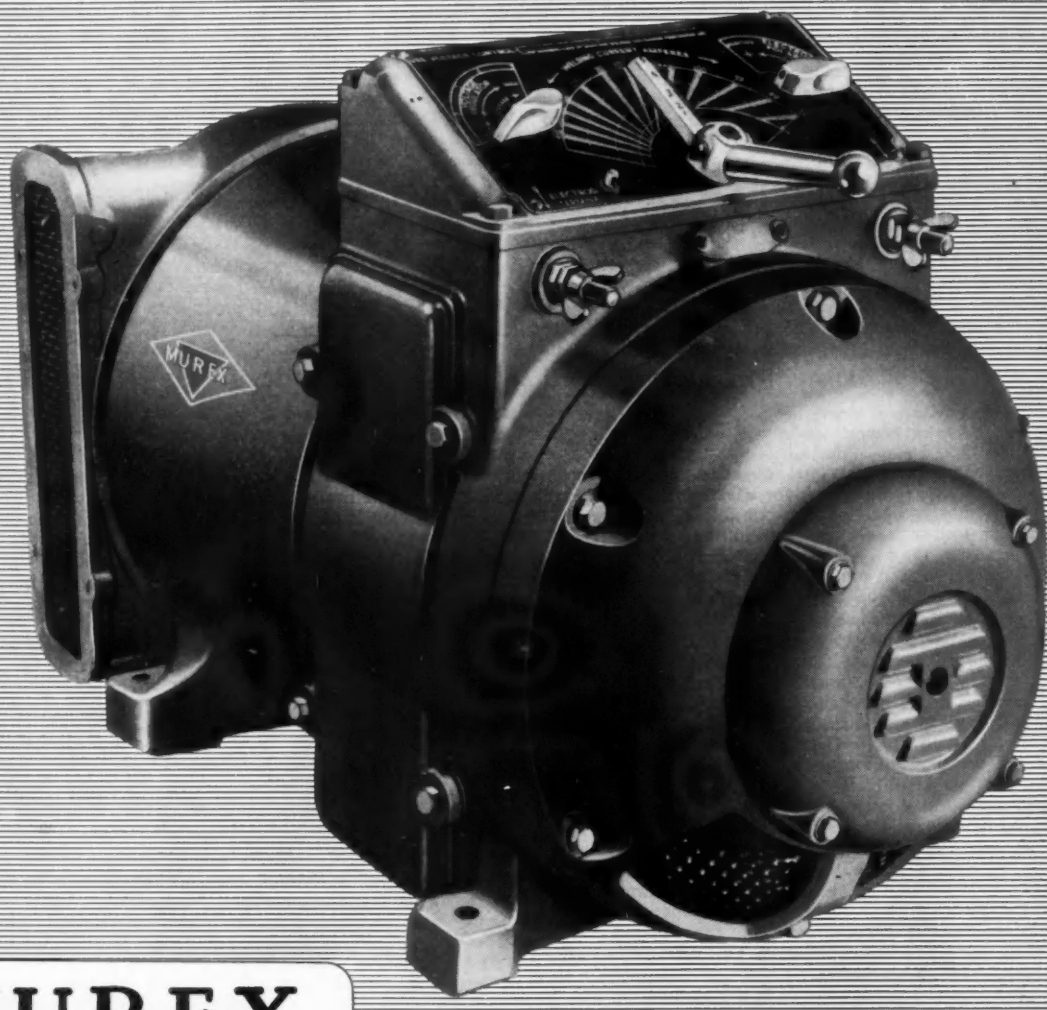
The inert gas used as a cooling medium is merely a mixture of atmospheric nitrogen and carbon dioxide, which contains at certain periods a little carbon monoxide with hydrogen and, maybe, other combustible gases from the coke. No special operation is needed to fill the system with inert gas, since the mere act of sealing off a chamberful of hot coke from the air ensures that the available oxygen is used up and converted to carbon dioxide. In the freshly charged chambers the carbon dioxide is partially converted into carbon monoxide by reaction with the coke, and this combustible gas leaves the chamber with the circulation gases. The hot-gas collecting flue is at a comparatively high temperature, and the controlled admission of air to this flue serves to burn off the carbon monoxide and other combustible gas present, any extra heat thereby generated being absorbed by the boiler system. In one installation as originally installed the coolant used was producer gas, which was then used as the fuel gas for heating the coke ovens. In this case, the coke oven battery was of the waste-heat type, and the waste gases raised enough steam for plant requirements. Several plants of the standard type have been installed and the following is a description of one of them as installed in conjunction with a coke oven battery at a steelworks.

500 Tons Per Day

The plant comprises 19 cooling chambers serving a battery of 57 ovens, that is, one chamber to every three coke ovens. The carbonizing time being 21 hours, each coke oven charge must be cooled in seven hours. The capacity of the plant is 500 tons of coke per day; the coke is pushed direct from the ovens into the cooling chambers and, when cooled, is discharged by gravity on to a belt conveyor for transmission to the coke screening plant. Each of the cooling chambers has a capacity of approximately eight tons of coke and is built of firebrick, with a flat-arched roof. When charged into a cooling chamber, the coke falls on to an inclined stepped grate forming the floor, through the steps of which the inert gas issues and passes through the coke. The grate is inclined to facilitate the discharge of the coke after it is cooled.

The operation of the cooling chambers has to synchronize with the pushing schedule of the battery, and each chamber can be isolated from the gas-circulating system by means of valves, both on the hot and cold side. Control of the gas circulation is obtained by means of vanes on the inlet of the fans, and by putting more or less boilers into operation. The boiler plant consists of four Spencer-Bonecourt fire-tube boilers working in parallel. They are provided with superheaters and designed for a working pressure of 200 lb. per sq. in. Fitted directly to each boiler is an exhauster fan for circulating the inert gas through the system. A feed water heater is included in order to ensure the maximum thermal economy and to cool down the circulating gases to as low a temperature as possible before they re-enter the coke cooling chambers.

The coke had an ash content of 10 per cent. and its temperature at discharge from the oven was 960° C., and on discharge from the cooling chamber, 255° C. The volume of circulating inert gases was 2.430 cu. m. per metric ton of coke cooled. The temperature of the cool gas at entry to cooling chambers was 200° C., and at entry to boiler plant, 548° C. Boiler feed water was supplied to the plant at a temperature of 70° C., and some warm condensate at a temperature of 55° C. was returned to the feed. The steam raised was of 190 lb. per sq. in. gauge and a total temperature of 240° C. (approx. 80° F. superheat), and the boiler unit embodied a feed water heater heated by the circulating gases after passage through the boiler and before entry to the cooling chambers. The total available heat was taken as the sensible heat of the



MUREX DYNEX

—A NEW AND UNIQUE GENERATOR

Specially designed for welding

The Murex "Dynex" generator has been specially designed for welding. It employs a new and unique principle of current control giving infinite current adjustment between maximum and minimum at a practically constant open circuit voltage. This facility provides ideal characteristics for modern electrodes and techniques. In addition the open circuit voltage can be infinitely varied to meet the needs of special applications. Series resistances have been eliminated in this generator and it is fitted with a polarity change-over switch. An accurately calibrated indicator plate eliminates the need for instruments and provision can be made for remote control when required. The efficiency of the generator is high and it is very compact and neat in design. Please write for full details.

- ★ *Infinite current adjustment*
- ★ *Infinite voltage adjustment*
- ★ *Unique principle of operation*
- ★ *For d.c. metal arc welding and other processes such as argon arc welding*
- ★ *High efficiency*
- ★ *Compact design*

E19

MUREX

MUREX WELDING PROCESSES LTD., WALTHAM CROSS, HERTS. · Telephone: Waltham Cross 3

coke between coke temperatures at inlet (960° C.) and outlet (255° C.) plus the heat evolved by the combustion of the coke, viz.,

$$334.1 - 61.5 + 54.2 = 326.8 \text{ kcal. per kg.}$$

The heat in the steam raised per kg. of coke cooled was 255.6 kcal. The overall efficiency of the plant was therefore:

$$\frac{255.6 \times 100}{326.8} = 78.15\%.$$

These results are fairly representative of those obtained at other plants of this type working under similar conditions.

As regards the economics of the plant, Gilles states that as at May, 1951, the all-in cost of the steam raised under the conditions then existing in Germany, totalled 3.26 DM. per metric ton of superheated steam (approx. 5.6 shillings per ton), while at the same period steam at similar pressure and superheat from fuel-fired boilers cost 7 DM. per metric ton (approx. 12 shillings per ton) or more. Although these figures have little validity in this country and at the present time, it is probable that the present-day fuel prices here would show an even greater advantage in the application of coke dry cooling. In this estimate of cost, there are several points to which attention should be drawn:—

(1) *The plant is assumed to work 350 days per annum at full normal load.*
(2) *No credit is taken for the enhanced value of the accurately screened breeze.*
(3) *It is assumed that the total return from coke is the same as for wet-quenched coke.*

To justify this claim, the following assumptions must be made:—

(*a*) That sufficient water is added to the coke to give it the same moisture content as wet-quenched coke. That this can be done was established in the Working Group Report which showed that up to 10% moisture can be added to dry-cooled coke even after the coke has cooled to atmospheric temperature.
(*b*) That the combustion of the coke in the cooling chamber is balanced by the combustion of coke in the hot coke car of a wet quenching plant.

The application of Collin coke dry cooling plant to intermittent vertical chambers has only been carried out on one plant, which comprised nine intermittent vertical chambers in three settings of three (since doubled). Each chamber has a nominal coal capacity of 2.8 tons, and the plant was designed for a gross carbonizing time of 14.4 hours.

The cooling chambers are situated immediately below the settings, one cooling chamber serving three ovens. A travelling combined lid-lifter and hot coke chute guides the discharged coke into the cooling chamber immediately below. The cooling chambers are built of fireclay refractories, insulated on the outside walls and fitted with louvre-type cast iron floor plates set at an angle, which ensures the cooled coke sliding freely on discharge.

This plant, which is the only combination of its type that has been built, has been in continuous operation for over 20 years. During that period, it has been worked under varying loads from a minimum gross cooling period of 4.8 hours to a maximum of nine hours corresponding to gross carbonizing periods of 14.4 and 27 hours respectively.

The operating results after the plant had been in operation for nearly four years show a somewhat lower steam yield at full load as compared with coke oven practice. This is indicative of the lower hot coke temperature resulting from steaming the charge—of the order of 10%, and the effect of reduced load on the overall efficiency of the plant. At 80% nominal full load, the steam raised per ton of coke cooled is reduced by 11% and at 50% load by 33%.

Over the 20 years' operation, defects have been noted—not unexpectedly in a pioneer plant. These resulted in difficulty in adequate maintenance and difficulty in entirely preventing the uncontrolled ingress of air, and could be corrected in future installations.

The Sulzer System

Sulzer coke dry cooling plants are built in the three following main types: Bunker type, chamber type, and fire-tube type. The three types are distinguished by cooling chambers of different design and by some divergences in their working principles. The choice of type is an individual matter depending on the local conditions in each works.

(*a*) *Bunker Type.*—The hot coke is discharged from the carbonizing plant into a hot coke car in the manner appropriate to the type of carbonizing plant, and the load of incandescent coke is then conveyed as quickly as possible to the dry cooling plant.

The cooling medium is an inert gas mixture which is kept in continuous circulation. The heat contained in the incandescent coke is absorbed by these gases, to be given up to the saturated steam in the superheater system and to the water in the boiler. The length of the cooling process and the intervals at which coke becomes available from the ovens are arranged to correspond. The cooled coke is removed from the bunker by special discharge equipment, and handled from there in the manner best suited to site layout.

This type of plant has been installed in conjunction with intermittent vertical chambers, horizontal retorts and coke ovens.

Cooling Plant

The cooling plant has a full load capacity of 700 tons of coke per day, and consists of two units, each unit being provided with its own coke container, boiler and preheater, together with a dust trap (for coarse dust) and a cyclone (for fine dust). Two fans are provided, each capable of taking the normal load, but arranged to work together—in series or parallel—if the need arises, e.g., when all the coke is being handled through one container. To limit the amount of coke discharged when opening the doors, mechanically operated 'pokers' are inserted through the chute near the junction with the body of the container. The 'pokers' hold the main body of coke while the chutes are emptied. The smoke-tube boilers and preheaters are of conventional type, normal boiler operating pressure being 175 lb. per sq. in., and the steam made about 1,000 lb. per ton of hot coke charged.

Cyclones are fitted between preheaters and fans to remove fine dust which is discharged through electrically driven barrel valves to prevent air being drawn into the system. This dust is eventually sent to the screening plant. The gases leaving the fan enter near the bottom of the container through double ducting fitted with dampers to control relative gas flow and connected to distributors in the middle of the coke. The distributors are constructed in pyramidal form from special cast iron segments capable of withstanding temperature and abrasion.

After discharge of the hot coke into the coke car, it is dropped from the car (which is divided into two compartments) into the empty skips, one for each container. The skips are elevated, and when they reach a pre-determined point the lids of the containers are automatically lifted, and stay raised until the skips are on the downward journey.

The most important points to be remembered about this plant are:—

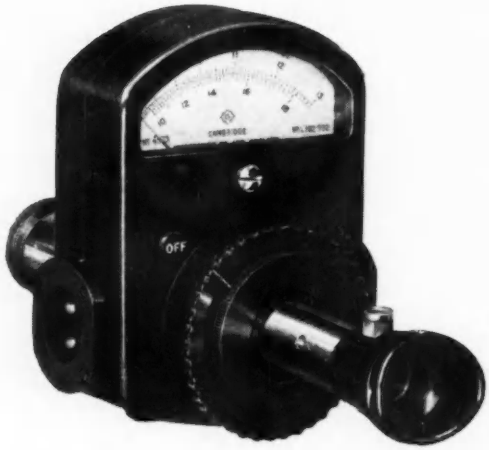
(1) The plant is simple and easy to operated, and there is but one golden rule to follow: 'Do not allow air to enter the system.' Therefore, maintenance is of first importance.
(2) The necessity to have a stand-by wet quenching installation.
(3) Such combustion of coke as does take place is minute and not calculable. The actual weighed dry coke yield appears to correspond with the theoretical.
(4) The coke produced is harder and smaller than with wet quenching, due to the relatively rougher handling the coke receives.
(5) Breeze produced is greater. This is due to the rougher handling of the coke plus the fact that, while with dry cooling screening is 100% efficient, with wet quenching this is certainly not the case.

(*b*) *Chamber Type.*—To a Sulzer dry coke cooling plant of the chamber type, a truck brings the full skip from the carbonizing plant. Before the commencement of cooling, the door of the chamber is closed by locking gear which seals off the chamber during the cooling process, and an inert gas mixture is circulated in the closed circuit. The cooling blower delivers the gases through the incandescent coke in the skip, which is designed to ensure good distribution of the coolant gas and

Cambridge **DISAPPEARING FILAMENT PYROMETER**

for

COMBUSTION CHAMBER TEMPERATURES

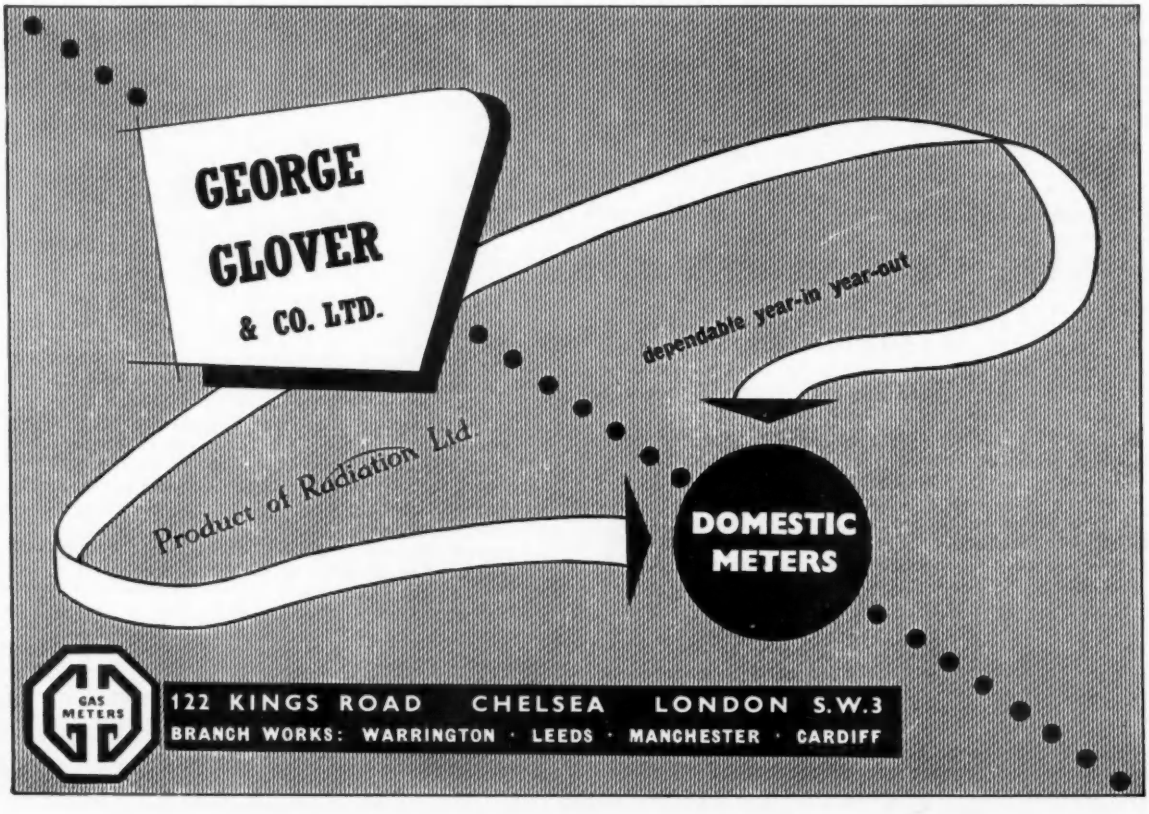


Combustion Chamber Temperatures can be conveniently and rapidly measured by the CAMBRIDGE DISAPPEARING FILAMENT PYROMETER. It is supplied as standard equipment by the principal retort constructors in this country and is used by hundreds of gas engineers

ROBUST **QUICK IN ACTION**
ACCURATE **SIMPLE TO USE**

CAMBRIDGE
INSTRUMENT CO. LTD.
13 GROSVENOR PLACE, LONDON, S.W.1
WORKS: LONDON & CAMBRIDGE

Write for our List No. 990D



thus uniform cooling of the coke. The heat carried by the circulating gas is used for raising steam in the boiler.

The duration of the cooling process depends partly on the works time-table, and partly on whether the plant is a single-chamber, double-chamber or multiple-chamber arrangement. For the single-chamber system, the time intervening between two oven discharges, minus the time required for transport of the hot and cooled coke, is available for cooling.

A double-unit plant of the same skip dimensions has a cooling period twice as long. A double-unit plant or a battery arrangement of several units has the advantage that the coke can be dry cooled even during overhaul periods, the chambers that are still in service being exploited more intensively by shortening their cooling times. For this purpose, it is only necessary to stop the cooling process at a somewhat higher temperature. Only one plant of this type has been installed in this country, and is no longer in commission. A number have been installed on the continent in conjunction with horizontal retorts, vertical chambers and small coke ovens.

(c) *Fire Tube Type.*—The full coke skip is removed from the transport truck on a roller system, and can be taken out of the cooling plant in the same way. When the charge of incandescent coke is run into the cooling chamber and the skip comes into its end position, communication with the delivery pipe of the cooling blower is automatically established. The cooling space is a pipe of diameter large enough to take the skip and its contents, and is built directly into the water space of the boiler. As in the other types, an inert gas mixture is used as the cooling medium. This type, however, differs from the bunker and chamber types in that the heat of the incandescent coke is transmitted to the boiler water only in part by convection, as a great deal of it is given off by direct radiation to the surrounding walls and thus to the boiler water in contact with them, this radiation being particularly strong at the beginning of the cooling process. After completion of the process, the skip of cooled coke is conveyed on the truck to a discharge point, from whence it is handled as best suits site conditions.

Defects

The original coke-cooling plant, now under reconstruction, which worked for three years before the second world war, had certain defects, despite which it produced steam at a lower cost than any direct-fired boiler unit. These defects were due mainly to the layout of the cooling boiler units (ten in number) on an elevated platform at the end of the carbonizing house. This involved a large number of operations (including the hoisting of the hot coke) and consequently an appreciable time, which not only left little margin for delay, but also tended to cause overheating and distortion of the hot coke containers.

In the reconstructed plant, the coke-cooling boilers will be re-positioned at ground level, and the hot coke car tracks underneath the carbonizing chambers will be extended in front of the boilers. The plant will be laid out in two independent halves, each serving half the carbonizing plant. The hot coke will be discharged from the carbonizing chamber into a container which will be brought to a position near the boilers. Simultaneously, a pusher machine running on independent tracks in front of the boiler will transfer a container of cooled coke from the cooling chamber to a tippler, and then bring the container with hot coke into the empty cooling chamber. The output of boilers would be 14,500 lb. per hour and, basing on the pre-war experience of this plant, it was expected that the cost of steam (under 1952 conditions and including capital charges) would be about 25% less than that from breeze-fired boilers. The labour required on the Sulzer dry-cooling plant is approximately equivalent to the labour for wet quenching, and, if this reduction is credited to steam production, the cost of the steam from the dry-cooling plant is only 60% of that from breeze-fired boilers.

The Integral System

The integral type of carbonizing plus coke-cooling plant, is a direct development from the continuous vertical retort. In the latter there is, in effect, a continuous discharge of cooled coke from the base of the retort into a closed container, which forms an extension of the retort. In the integral system there is an intermittent discharge of hot coke into a closed container, likewise forming an extension to the retort. In both cases, the main cooling medium is direct steam, this steam and the products resulting therefrom passing into the retort and joining the distillation products.

Initially, *i.e.*—on commencement of admission of steam, the coke temperature will permit the formation of water gas. Assuming the initial coke temperature to be 1,000°C., the water gas reaction will continue till the coke temperature falls to 850°C., and will absorb some 2.75 therms per ton of coke cooled. The remainder of the heat in the coke (apart, of course, from radiation losses) is utilized in superheating the steam, which will pass to the retort where further water gas formation will take place. Steaming would reduce the coke temperature from 850° to 785°C., but it would appear that to cool the coke to a safe discharge, temperature will either necessitate fairly heavy steaming or the dissipation of the heat by other means.

There are two known types of this plant, the 'Westvertical' and the 'Static.'

'*Westvertical.*'—Several plants of this type have been installed, and one of them has been described by Battersby. The carbonizing unit is completely enclosed from the gas-tight coal valve at the top to the discharging door at the bottom, and these are opened only at the end of the carbonizing period to admit coal to the chamber and to take cooled coke away from it. The unit may be regarded as divided into three zones. The lowest or cooling zone extends from the discharging door upward through a bricklined cooling chamber. Above this lies a comparatively short zone extending through the two bottom combustion chambers of the setting, which is known as the conversion zone, since there the coke is maintained at a temperature sufficient for the water gas reaction. The uppermost zone is the carbonizing zone, in which the distillation of the new charge takes place.

At the end of the carbonizing period, the cut-off at the top of the discharging chamber is closed and the discharging door at the bottom is opened, both operated mechanically, and the contents of the discharging chamber pass to the coke conveyor. The discharging door is then closed and the cut-off opened, allowing the charge to drop into the discharging chamber. This process is immediately repeated, leaving the two lower zones filled with hot coke and the carbonizing zone ready to receive the new charge. The coal valve is opened and the coal flows through the feeding 'box' until the top of the charge is within a predetermined distance of the top of the mouthpiece. The coal valve is closed and the carbonizing period begins. The coke is discharged at a temperature of about 300°C.

Continuous Water Gas

Steam is admitted continuously at two points, one at the base of the cooling chamber and one above the cut-off. It is superheated as it pasess through the initially hot coke, and above this in the zone of higher temperature the production of water gas commences. Thus the production of water gas is continuous, and, for the first few hours after charging, advantage is derived from the heat of the coke in the cooling chamber. The amount of steam is limited to 10% by weight of the coal carbonized, and this steam is added continuously at a steady rate throughout the carbonizing period. The scurfing procedure is to admit air and steam through the open bottom door for ten hours, then the bottom doors are closed, the steam is shut off, and air is caused to circulate in the chamber from the top.

Static-retort.—This type has been installed in several works, and one such plant has been thoroughly investigated by Burgess and Neill. The working of the system is as follows: The retort is rectangular in plan and consists fundamentally of two superimposed portions, the upper of which forms a coal carbonizing zone similar in proportions and construction to a lambently heated intermittent vertical chamber, while the lower portion forms a zone in which the coke is cooled by both the introduction of steam and transfer of heat to the surrounding atmosphere. The steam becomes superheated on entering the cooling chamber, and, as it ascends in contact with the hot coke, gives rise to the formation of water gas. The water gas and undecomposed steam in turn ascend through the car-

bonizing zone, where they become intimately mixed with the coal gas being produced, the gaseous mixture leaving by way of the top gas offtake.

The cycle of operations is as follows:

(*a*) While the coal charge is being carbonized, steam is admitted to the cooling chamber containing the coke from the previous charge.

(*b*) At the end of the carbonizing period, the steam is turned off, the top gas offtake valve closed, the retort charging lids removed, the discharge door opened, and the extractor roller started. Extraction of the cooled coke from the cooling chamber is continued until the top of the superimposed hot carbonized charge is lowered to the level of the bottom of the carbonizing zone. The discharge door is then closed.

(*c*) The last charge carbonized, which is then mainly in the cooling chamber, remains an unbroken column.

Assessment

The advantages of coke cooling by inert gas can be summed up as follows: On full normal load, up to 1,000 lb. of steam can be raised per ton of coal carbonized; there is practically perfect screening of the coke; all screened coke is dust free; the coke is free from fliers; there is reduced corrosion of surrounding plant; and the national fuel economy is improved by using otherwise wasted heat.

The disadvantages of this type of plant are, the high capital cost, loss of coke due to combustion during the cooling process, the dry cooling of coke introduces another operation into the carbonizing process, the dust nuisance is intensified, and the lack of revenue due to lack of moisture in coke. There are other disadvantages, such as dependence on a constant steam supply from the boilers of these installations, and the difficulty of disposing of breeze. Both these can ge got over by having plenty of standby plant for steam raising and by gasifying the breeze.

The overall picture of the coke-dry-cooling system would appear to be that the system has outstanding advantages, is operationally and technically successful, and has no insuperable defects. Some existing plants, with all their faults, have been in continuous operation for over 20 years. What, then, is the cause of the obvious reluctance up to now to install coke-dry-cooling plants in conjunction with intermittent-type carbonizing plants? The basic reason has undoubtedly been that, hitherto, the return on the capital expenditure after all charges have been met is not attractive; in other words, the saving in the cost of steam raised as compared with solid-fuel-fired type of steam-raising plant is not large enough to provide an adequate return on the capital. But this statement is based on economic conditions no longer existing and not likely to recur; namely, and fundamentally, the low cost of solid fuel.

Where solid-fuel costs have always been relatively high, as in Switzerland, where there is no indigenous fuel, the system has been widely adopted. Some 80% of the coke produced in Switzerland is dry-cooled. On the other hand, in Sweden, where there is also no indigenous fuel, coke dry cooling has not been introduced. The reasons given are:

(*a*) The fuel saved by coke dry cooling would be coke breeze, which is not a very good fuel for furnaces.

(*b*) The amount of manpower and materials needed for the erection of such a plant in Sweden would for at least five years ahead mean a heavy loss in these items for Sweden.

But these reasons, although of consequence at the time (World Fuel Conference, 1947) have little, if any, validity today.

Under conditions existing in Switzerland, the amortization period for coke-dry-cooling plant is two to five years (1950). In Germany (1951), after allowing for interest and depreciation at 11%, the return on capital is of the order of 20%, and although the capital cost of dry coke-cooling units is about twice that of a normal stoker-fired boiler plant of similar steam-raising capacity, the overall cost of steam (from the coke-cooling plant) is about 55% of that from stoker-fired boilers operating at 80% load factor.

In this country, there has, since the last war, been a disproportionate increase in solid-fuel costs, and the apparent future tendency is for this disproportion to be accentuated rather than diminished. Surely the time has come for a re-examination of the economics of this process—a re-examination the urgency of which is underlined by the present and prospective national fuel positions.

DISCUSSION

Dr. G. E. Foxwell said Mr. Morris had reminded them of the various ways in which designers had approached the problem of bringing inert gas and hot coke into direct contact in order to transfer heat from the coke to the gas, and then in turn to transfer the heat from the gas to water in a boiler, which seemed a simple exercise in chemical engineering.

There was a striking analogy between dry coke cooling and atomic power stations. The means adopted for heat transmission were basically similar. If it paid to generate in this way electricity from an atomic pile in which the heat is released by a costly process, it should be found economically and technically possible to use much the same process to generate steam from hot coke, the heat from which was normally dissipated wastefully, and at some cost.

But the fact was that within the British Commonwealth most dry coke cooling plants had had a depressing history. A working party of the Ministry of Fuel and Power had reported in 1949 that though dry coke cooling was a reliable process provided that the plant was well maintained, a process which for coke oven plants merited careful consideration, it had at that time no economic attraction for gasworks.

On economic grounds it might be more attractive today in view of the increased price of coal, since it was most attractive in dear coal countries. The real reasons for the lack of success in mastering a comparatively simple technical operation were:—

1. On many plants insufficient attention had been paid to maintenance. If air was allowed to leak in deterioration soon became apparent.
2. The process had been regarded purely as a means of raising steam, and other advantages which could be secured from the process had not been considered. The gas industry was indulging in a lot of new thinking. Some of this new thinking should be applied to dry coke cooling. Every ton of coal or coal equivalent rescued from the thermodynamic sink would save the country no less than £7 in foreign currency spent in importing fuel, and there might be financial advantage to the gas industry.

Dry Cooling

One of the most important consequences of dry cooling was that the coke was kept dry. Only dry coke could be accurately sized. In particular it was possible to divide the breeze fraction accurately into further fractions. When, in this way, the dust below ¼-in. was removed a very considerable advance was possible in breeze-burning producers for heating the retorts, without requiring apparatus of inordinate size. This was one important way in which more large coke could be made available for the domestic market.

Even if it was not desired to use breeze-burning producers, the fraction ¼-in. to ½-in. could be sold for a substantial price.

Re-wetting

Having got dry coke skilful arrangement of plant might be expected to make use of the ability to screen accurately, to provide an important stage in the preparation of coke for the domestic market. Re-wetting to prevent dust nuisance would be the last stage. Moreover, the water content of the finished article would generally be under better control than it now seemed to be.

The value of the steam from dry coke cooling was not so much the absolute value in shillings a ton as the value by comparison with other sources. When steam was costed the cost of the fuel used to make it should be included and it should be remembered that the sensible heat of the waste gases leaving the heating flues of continuous vertical retorts contained about 50% of the heat of the coke fed into the producers. Thus half the heat of the coke fed into the producers in continuous vertical retorts and 35-30% in horizontals should be debited against the steam produced in the waste heat boilers and credited to carbonization. Likewise steam produced from dry coke cooling should be debited with one

quarter to one-third of the cost of producer coke.

The importance of this was that the value of the coke used to produce the steam and the efficiency of the steam-producing plant were taken into account, so that the economic advantage of the whole process, including the possible use of breeze in the producers, was assessed.

It was one thing to cool hard metallurgical coke in bunkers, an operation which did not give rise to any considerable additional breeze and in which some forms of breakage were beneficial, and quite another to cool in a similar plant gas coke, made possibly from lower-rank coals. For gasworks the skip types of plant in which the coke was not subjected to an additional rough handling was to be preferred.

A use should be found for dry coke dust below ¼-in. There were quite a number of possible uses, and some of those might be investigated.

It was fair criticism of Mr. Morris's paper that it was based wholly on past experience, mainly from published papers, and that he had not shown us how the mistakes of the past had been rectified in the plants of tomorrow. That there had been mistakes in the past was evident from the small measure of success achieved.

Another Link

When the whole of the coke had to pass through the dry cooling chambers this plant must add another to the links which, if broken, might cause partial or complete cessation of gas-making. This was an objection, but not too serious. The gas industry in its dealings with the coke oven industry on gas prices was well informed on the subject of stand-by plant. All that was needed here was that the installation layout should permit the dry cooling plant to be by-passed in favour of wet quenching if that should prove necessary.

When a substantial or any essential proportion of a works steam supply came from the dry-cooling plant any cessation of coke cooling must affect the steam supply. A stand-by boiler plant was therefore needed. What size should this have in relation to the output of steam from the dry cooling plant, and to what extent must the boiler plant be kept continually under fire?

The steam requirements of the works must be considered in relation to the amount of steam that could be made available without using fuel-fired boilers. Since dry cooling was a major operation it must be visualized as applied to a modern works. On the basis of data published in L. J. Clark's paper to the Institute of Fuel this year it appeared that the steam produced by a dry cooling plant on a gasworks using horizontals or intermittent verticals should be usable without any notable surplus or deficiency, and that no fuel-fired boiler should be needed. The balance was rather delicate.

T. C. Finlayson and D. T. Barritt stated in 'Fuel and the Future,' Vol. II, p. 232, H.M. Stationery Office, that a modern coke oven plant used between 400 lb. and 600 lb. a ton of coal, but that this could be reduced to 200 lb. Against this were the figures which Mr. Morris had quoted and F. Pearson's statement that at the Ford works the steam yield was 1,000 lb. per ton of coke, about 700 lb. per ton of coal. Clearly, the demand for steam and the possibility of making use of any steam generated from every form of 'waste' heat that was not required on the works must be carefully considered for each works individually.

Three Volatile Therms

When using static retorts and good gas coal it was regarded as important to retain three volatile therms in the coke. When such coke was tipped into a skip or bunker for cooling, there might be a tendency for some of these volatile therms to be given off by contact with hotter coke, or even by over-heating through combustion en route. When lower rank coals were used the additional handling might give rise to a lot more breeze.

In these times of capital stringency Mr. Morris should have enlarged on the question of capital costs. Dry cooling plants were most successful when the cost of fuel was high, but the capital cost of the plant had risen in about the same proportion as gas coal, so that the 'advantage' that dry cooling would have because of dearer fuel had been largely neutralized.

The cost of maintenance need not deter those who felt disposed to erect dry cooling plants. It was frequently stated that maintenance costs were high, but at the Ford plant, 14 years after it was put to work, the maintenance costs were 14% of the cost of steam—about 1.3d. per ton of coal carbonized.

Concluding, Dr. Foxwell congratulated Mr. Morris on bringing the subject up again, and on his 'comprehensive and altogether fair' presentation of past experience. There had been many failures and some outstanding successes, and there should be an enquiry into the possibilities, based on a wide and imaginative view of the value in various directions that could be derived from such a process in the light of advances in design and construction now possible.

Considerable Problem

Mr. G. Dougill said the problem of handling and dealing with dry cooled coke was considerable. It was easy to cool coke by dry methods from 900°C. to 950°C. down to some 300°C., but nobody ever seemed to think of working it below 300°C. Bulk coke at 300°C. was unpleasant and difficult material to handle, and far more so than the same material from wet quenching. Dry quenching, in view of fuel shortages, ought to be looked into further.

To make it a success it had got to be a case of not only moving it from 950°C. to 300°C., but to get that last bit of heat out and make it into a substance easy to handle. If, for instance, coke was dry-cooled from 950°C. to 300°C. and then immediately below the cooling chamber de-dusted or de-breezed, taking advantage of the dry coke to get rid of all the dust immediately in a dust-proof apparatus, then if the coke was slightly wet quenched to remove the remaining heat into a condition suitable for handling—something of the order of 3-5% of moisture—the ordinary screening plant would deal with that coke efficiently and properly. But coke at 300°C. passed to an ordinary screening plant was simply asking for trouble.

The author was to be congratulated on bringing this forward, but the idea that cooling coke, taking the heat out from 950°C., was the whole of the drill, would have to be discarded. Contractors would have to consider a plant from 950°C. to the customer—then there might be success.

Mr. F. S. Towney said that during the last 30 years, his company had built three carbonizing installations to which dry coke cooling plants have been attached. None of them had been a real success. Two plants attached to intermittent vertical chambers had not worked continuously throughout the life of the carbonizing plant, and the other, attached to the coke ovens had had to be kept at work, with some great difficulty, by the operating department simply because there was no adequate alternative to it.

It was significant that although commercial types of dry coke cooling plant had been available for at least 30 years there were few plants at work throughout the world. In the four leading countries in the way of carbonization—Britain, the United States of America, France and Germany—there was upwards of 150 mill. tons of coke produced annually from static forms of carbonization. It was doubtful whether there were 20 operating dry coke cooling plants throughout all that area.

Economic Aspect

It was unfortunate that the heat in the hot coke could only be produced at a low tension—in the form of steam—and as such it had to compete with steam produced in certain cases from waste boilers, in other cases from coke breeze, and in the case of the integrated steelworks from steam raised from blast furnace gas—all at a rather low price. It was disappointing that Mr. Morris had not pursued his assessment of the subject to cover the economic aspect and to indicate from actual operating plants the region in which it might be possible to find an economic application of dry coke cooling.

In any such assessment a re-examination of the problem should be undertaken; it was very important that such an assessment should allow of a margin over and above any arithmetical economic balance to cover the undoubted complications which arose in the operation of dry coke cooling plants.

There were three complications which loomed rather largely at any rate in the minds of the builders of the carbonizing plant itself. In the first place unless there was a really adequate capacity in the dry coke cooling plant the output of the carbonizing plant might be very much at its mercy. If, for example, the container for the coke had not a suffi-

cient margin to take care of the absolute maximum amount of coke in the broken-up form from one charge it might be found very difficult to keep the plant operating satisfactorily. More than that, there were from time to time delays on the carbonizing plant itself. With wet quenching it was possible so to speed up the delayed removal of the coke from the carbonizing plant that one got back again on to output, whether it were coke or gas, very quickly. It was very difficult to do that in the case of dry cooling plant because it was not possible to speed up the cooling, and very frequently, therefore, one had to face up to a loss of throughput of the carbonizing plant which was lost for ever.

It was therefore essential that the proper wet quenching plant should be installed at the same time as the dry coke cooling plant. It should be remembered that any bottleneck on the shifting of the hot coke became a very serious matter when dealing with large plants, where something like three tons of coke have to be dealt with every quarter of an hour, and in the case of coke ovens it was not unusual to have batteries which would deliver 12 tons of coke every quarter of an hour.

The second point was that of maintenance. It could not be overlooked that when one was dealing with hot, dusty charges of coke it was essential to have maintenance of a very high order, and in addition, that maintenance must stay of the same high order over a number of years which would cover the life of the carbonizing plant.

The relative, and perhaps complete, success of dry coke cooling in Switzerland might be due to the fact that it had been applied on relatively small plants where there was plenty of time for maintenance and a margin in the speed of cooling which would enable the carbonizing plants to be kept going at full capacity.

The third point which loomed very much with the designer of carbonizing plant and its attached ancillary plant was that of the dust. Absolutely bone-dry coke was very difficult to deal with without creating a dust nuisance, and to deal with it by means of industrial apparatus was always adding to the cost.

Mr. W. R. Garrett said there was no doubt that the most troublesome problem associated with intermittent vertical retorts was the quenching of the coke, and while in the North they had been considering the Le Fleuve conveyor for handling I.V.C. coke the present normal solution left much to be desired.

The author claimed ten advantages for coke dry cooling, but some of these claims could not go unchallenged. The real advantage of dry cooling of coke was summed up in the tenth claim, and that was removing the high maintenance cost of coke cars and the problem of dealing with the breeze sludge from quenching water settling pits. To this item could be added the difficulty of maintaining a low and consistent moisture content of the coke for sale.

The author gave nine disadvantages for coke dry cooling, but the real stumbling block was having to provide quenching facilities for use while inspecting and repairing cooling chambers, together with a possible increase in the height of the retort house building.

Unfortunately the paper contained no real information on the suitability of dry cooled coke for the domestic market, and it was hoped that the author, or others, will make good this omission. It was possible that the ultimate answer might be dry cooled coke wetted with a 2 or 3% solution, by volume, of sodium carbonate to increase ignitability but, until the question of suitability of the resulting coke for the domestic market was firmly established, dry cooling, under present circumstances, would not be attractive.

Abstract of I.G.E. Communication 484.

Liquid Methane

By J. BURNS, G.M., B.Sc., Ph.D., M.Inst.Gas E., M.Inst.F.,

and L. J. CLARK, B.E.M., M.Sc.(Eng.), M.I.Mech.E., M.Inst.Gas E., A.M.I.C.E., A.M.I.E.E.,

Chief Engineer, and Development Engineer, North Thames Gas Board.

HOME-produced coal, which at one time was practically the only source of thermal intake to the industry, is in short supply and we are dependent on imported coal to feed a proportion of our carbonizing plants. Additional gas loads are being met by the increased usage of oil. The quest for other raw materials is particularly important to the industry at the present time, for there is an ever-increasing demand throughout the country for energy, and the gas industry has to make its best effort to maintain and, if possible, increase its share in the supply of refined fuel. Developments in the gasification of oil have redressed the position to some degree, but the industry has to be wary of becoming over-dependent on oil because its usage of oil could very well be affected by developments in other oil markets, over which the industry has no control.

An alternative fuel, natural gas, occurs throughout the world in two forms: As gas by itself and as gas in association with oil, and, in general, gas in association with oil has to be expended in producing the oil. In the Middle East alone, it is estimated that more gas is being flared to waste than would be required for the total current needs of the British gas industry, and similar large quantities are being lost in Venezuela and other parts of the world. There was the famous Bechtel project to carry natural gas from the Middle East across many different continental countries even as far as London. This project stopped, not so much because of any insurmountable technical or economic difficulties, but, rather, from the political difficulties associated with crossing frontiers. The whole conception of natural gas transmission took on a completely different aspect when first it was shown possible to liquefy gas to gain the advantages of thermal concentration to give a material occupying only 1/600th of its volume in the gaseous state.

Natural gas consists of hydrocarbons, principally methane with ethane, butane and propane, plus some inert gases as nitrogen and carbon dioxide and some sulphur compounds. Natural gas from a dry gas in which there is no oil consists essentially of methane and substantial proportions of the heavier hydrocarbons including propane and butane. These heavier hydrocarbons can be readily separated from the main stream of gas either by the application of high pressures or low temperatures. Normal butane will liquefy at a temperature of 100°F. if the pressure is raised to 37 lb. per sq. in. gauge, or at 31°F. under atmospheric pressure. Propane, however, requires a pressure of 175 lb. per sq. in. gauge at 100°F., or a temperature of −44°F. at atmospheric pressure. Either of these relatively moderate pressure or temperature conditions can be used to retain these hydrocarbons in their liquid state, and ships, rail tank cars, road vehicles, and static storage tanks for handling butane and propane have been in use for several years. Liquefaction under pressure rather than low temperature has been the principal method adopted for retaining the gas in the liquid form, but there is a move now to apply low-temperature techniques for more economic operation for large-scale transportation.

The science of gas liquefaction is no newcomer, for it has found application in important industries for many years. It has been used as a means of separating the constituents of coal

NEARLY PERFECT

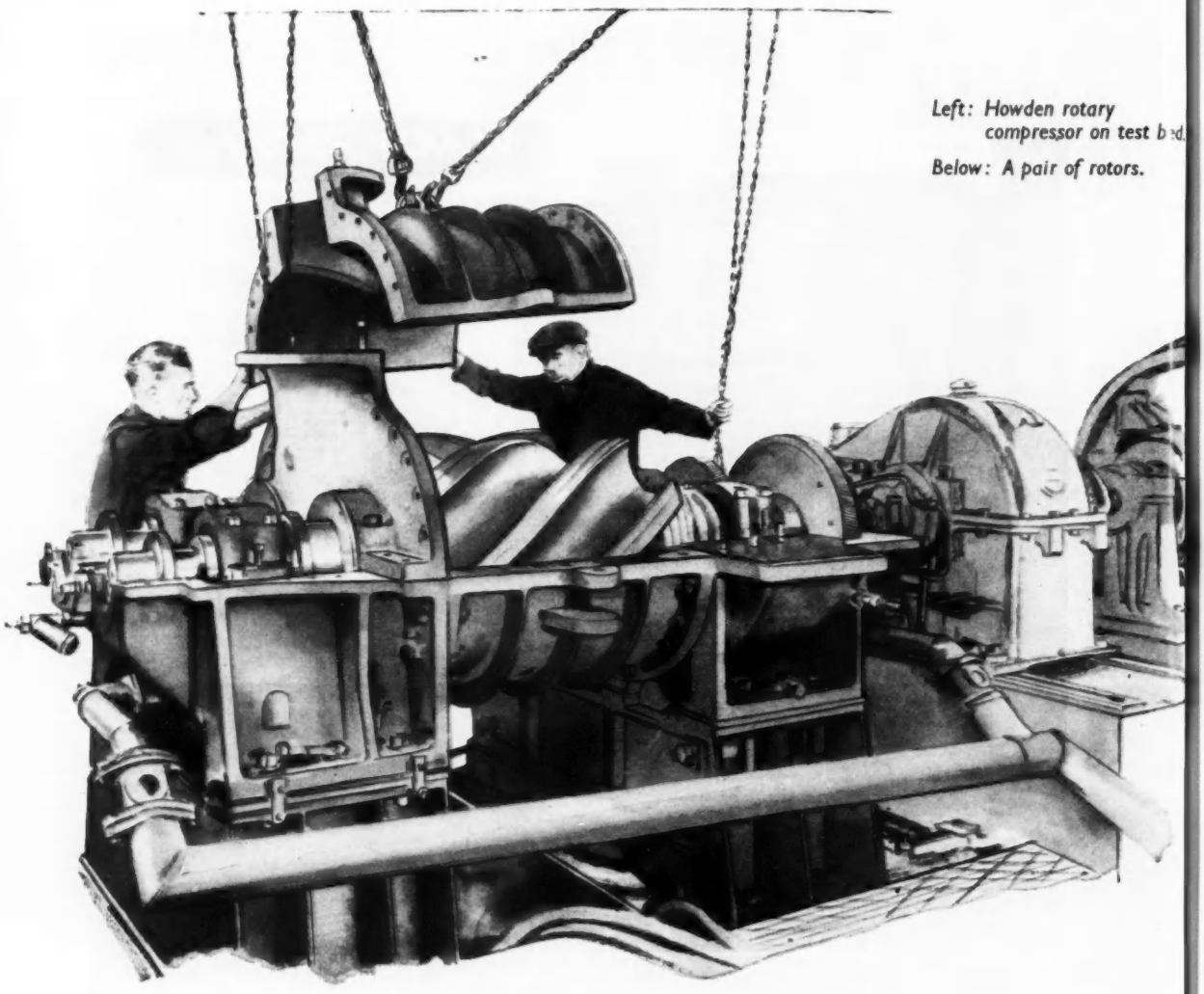
THE
4-D
METER

The Meter with four single-acting diaphragms; the most recent development in meter design.
Approved by the Ministry of Fuel and Power; and conforms to the standard dimensions of the Institution of Gas Engineers for D.1/100 ft. Meters.

METERS LIMITED · FOUR-DIAPHRAGM ·

The Gas Meter with the most efficient registration system in the world.

METERS LIMITED
MANCHESTER AND BRANCHES
TELEPHONE · BLAckfriars 0387 · TELEGRAMS 'BRITMETER MANCHESTER'



Left: Howden rotary compressor on test bed.

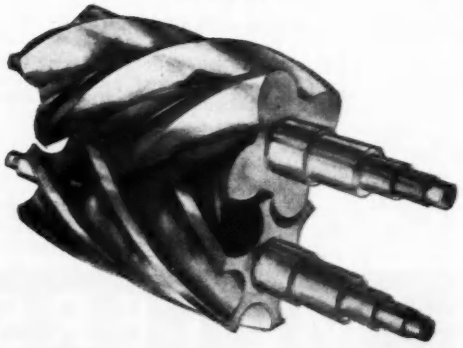
Below: A pair of rotors.

OIL FREE DELIVERY

with

Freedom from vibration.
Maintained efficiency. Low running costs.
Continuous flow and reliability.
Air or gas being compressed does not come into contact with oil bearing surfaces.
Capacities from 400 to 8,500 C.F.M.
Pressures up to 150 lb./sq. in.
Gauge vacuums to 1·5 lb./sq. in. abs.

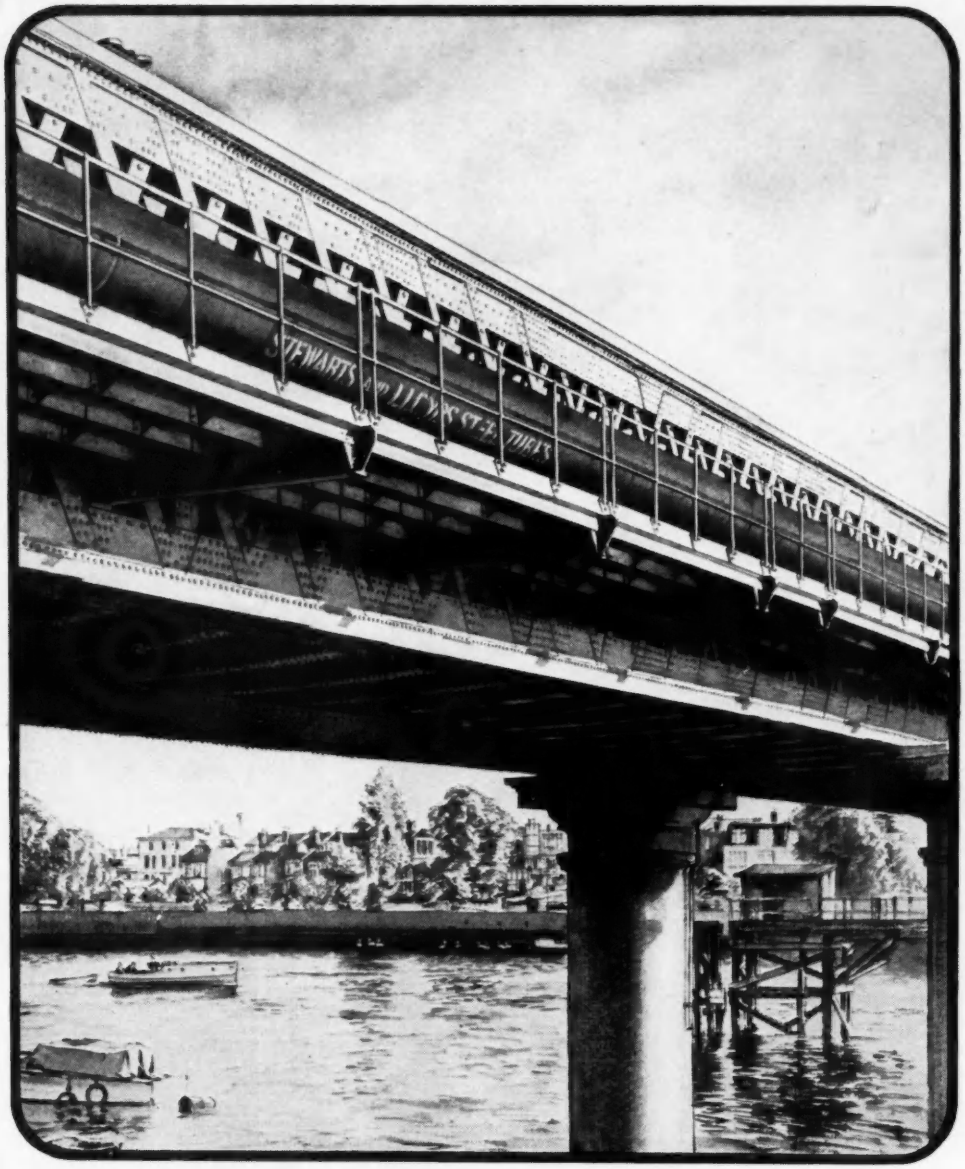
POSITIVE DISPLACEMENT ROTARY



HOWDEN
COMPRESSORS AND EXHAUSTERS

Telephone enquiries to Compressor Division: Halfway 3346

JAMES HOWDEN & CO. LTD., 195, SCOTLAND STREET, GLASGOW, C.5. and 15, GROSVENOR PLACE, LONDON, S.W.1



THE STEEL TUBE AGE

Steel gas main, 36¾ in. outside diameter,
with sleeve joints welded externally (see section below),
installed by the North Thames Gas Board
across the River Thames at Putney.

STEWARTS AND LLOYDS LIMITED

GLASGOW · BIRMINGHAM · LONDON

S&L

In a coming age
a coming of age
We announce with pride the complet
our first twenty-one years hydraulic
to world industry.
We were pioneers of hydraulic
transmission in industry and a
the recognised authority. Co
of our responsibilities we
ward with our whole re
to take a leading role
ever expanding
applied hydraulics
Keelavite
THE RECOGNISED AUTHORITY ON HYDRAULIC POWER TRANS

gas, and at the suggestion of British engineers liquefaction plants were installed in the United States of America in 1917 for the separation of helium from natural gas, and since that time several large-scale plants have been built and are being operated in the U.S.A. Much pioneer work was carried out by Egerton who suggested in 1937 that the separation and storage of liquid methane might be used in the gas industry in this country to help meet the peak-load problem.

The next development in the field of natural gas liquefaction was the Mississippi barge transportation scheme. This project provided for the liquefaction of natural gas near its source in the Gulf Coast area, with transportation of the liquid in insulated tanks in barges up the Mississippi and canal system to Chicago. Each barge was designed with five insulated tanks of 50 ft. diameter and 25 ft. high, to be capable of carrying the equivalent of 120 mill. cu.ft. of natural gas. The intention was to evaporate the cold liquid on arrival at Chicago and to use the potential cold content of the liquid as a refrigerant for the cold storage installations there, with the use of the gas for heating purposes.

This project is progressing; the construction of the liquefaction plant and first transport barge is practically completed and operating trials are at present in hand. The growth of scientific knowledge and technical 'know-how' since the inception of this scheme may very well widen the scope of the whole installation, and the barges may be used additionally for other purposes.

Sources and Quality

Natural gas is derived from three types of reservoir, dry natural gas reservoirs, condensate reservoirs, and crude oil reservoirs. In the U.S.A., a large proportion of the natural gas is derived from gas-bearing reservoirs where it exists unassociated with oil. Gas from these 'dry wells' is usually at fairly high pressures around 2,500 lb. per sq. in. gauge and contains over 90% of methane. Large quantities of natural gas containing between 60 and 90% of methane are also derived from condensate reservoirs where the gas exists mainly in solution under high pressure. The third major source of natural gas is crude oil under pressure, which releases its gaseous constituents when the pressure is reduced at or near the well-head prior to refining or loading. Gas derived from this source is geared directly to oil production, and in many oil-bearing areas of the world, including the Middle East and Venezuela, most of the natural gas is produced in this way. From the Middle East crude from the high-pressure field, the gas yield from the multi-stage separators can vary from 5 to 15 cu.ft. per gal. of oil. A typical gas produced from this source may contain 20% of propane and butane, up to 0.1% of hydrogen sulphide, 4% of carbon dioxide and 3% of nitrogen.

Of the many reserves of gas at present known to exist in the world, it would appear that those in the Middle East, Venezuela, and Mexico are likely to be the most suitable geographically for supplying liquid gas to this country. In all of these countries, large reserves of gas are available and overseas shipment will be facilitated as the gas reserves are relatively near to the sea ports and there is only limited potential local demand. In addition, it is believed that in these countries there are considerable reserves that have not as yet been explored. From the technical aspect, it is not a matter of primary importance whether the heavier hydrocarbons such as propane and butane are removed from the gas prior to liquefaction, as they can remain in true solution in the liquid methane and do, in fact, raise the boiling-point, thereby reducing the amount of energy required to liquefy the gas. The presence of these heavier hydrocarbons raises the calorific value of the re-evaporated gas.

The pressure at which the natural gas is available has an important bearing upon the choice of the liquefaction process and the power required for re-cycle compression.

Processes for Liquefaction

Techniques for the production of low temperatures and the liquefaction of gases have been known for many years, and by the turn of the century there were three recognized systems: the Joule-Thomson Effect, of Lindé, the Expansion System, developing external work, of Armongood and Claude, and the Cascade System, of Tellier Pictet, etc.

The Joule-Thomson Effect applied by Lindé is the oldest system and the earliest applications of the principle were directed mainly to the production of liquid air and subsequent separation of the oxygen. The inclusion of expansion engines in place of a throttle valve as introduced by Armongood and Claude has advantages in larger plants as the expanding gas is caused to do work in the engine or turbine and consequently suffers a greater reduction in temperature. The cascade refrigeration system usually consists of two or three closed expansion cycles operating in series with each other at different levels of temperature.

Cost of Power

The cost of power is a major item in the total operating charges of any liquefaction plant, and various refinements and combinations of the basic processes can be made to reduce the power consumption necessary to liquefy natural gas. The extent to which this is economically justified depends upon the relative value of fuel and capital plant at the site where liquefaction is required. In the case of the cascade liquefaction process adopted at Cleveland, the fuel consumption of the gas-engine-driven compressors was equivalent to approximately 24% of the gas liquefied; in the case of the simple and cheaper expander system adopted for the Mississippi barging project, the fuel consumption is estimated at 35%. More recent designs have shown that it is possible to reduce the fuel consumption below 10% and it becomes primarily a problem in economics to determine how far improved efficiency is justified on account of initial plant cost. If the liquefaction plant is to be sited close to the gas-fields where the value of fuel is low it is probably not worth striving for the best fuel efficiencies, but, if the plant is to be located far from the source of gas, fuel costs become a major item and higher efficiency is desirable.

Storage

Several designs of storage tank have been developed for liquids at low temperature, although only limited experience has been obtained in actual operation. The tanks constructed for the original liquid natural gas storage plant at Cleveland consisted of three spherical units having double shells of welded construction, the inner 57 ft. diameter shell was fabricated from low carbon, 3½% nickel steel and was supported within a mild steel outer shell with 3 ft. of cork insulation between. The lower sector of this insulation was of preformed cork slabs for supporting the load and the upper portion was packed with granular cork. Each tank was provided with two 12-in. diameter safety valves set to relieve at 3 to 5 lb. per sq. in. gauge and backed up by two 12-in. rupture discs set to break at 7 lb. per sq. in. gauge. The fourth tank, which was built three years after the installation was put into service, was of a vertical cylindrical type having double dished or toro-segmental ends. The inner cylinder was 70 ft. in diameter by 43 ft. high, and the 3 ft. space between the two cylinders was packed with rock-wool insulation. The entire inner container was mounted on some 90 timber posts supported on a concrete foundation. The heat losses from the spherical tanks were found to be lower than anticipated and the measured rate of 'boil off' was equivalent to 0.23% per day of the tank contents. Some eight months after the toro-segmental tank was commissioned, it ruptured and discharged its entire contents, resulting in disaster. It is noteworthy that adjacent tanks were unaffected by the disaster. A significant conclusion is given in the following statement from the Bureau of Mines Report:

> 'Regardless of the cause of the disaster at the liquefaction storage and regasification plant of the East Ohio Gas Company, the application of the system for liquefying and storing large quantities of natural gas is not invalidated, provided proper precautions are observed.'

The only plant known to have been built since the Cleveland installation is one for Moscow. This plant was designed and constructed by Dresser Industries, Ltd., of Dallas, Texas, in 1947. The plant has a liquefaction rate of 4.5 mill. cu.ft. per day by the cascade principle with a storage capacity of 162 mill. cu.ft. The storage reservoir is of unusual design with 100 individual cylindrical vessels each of 10 ft. diameter by 42 ft. high. It has also been suggested that satisfactory storage tanks could be designed on the principles used for the Mississippi barges, in which a mild steel tank could be insulated on the inside with balsa wood carefully glued and jointed to form a liquid-tight lining.

In the processes of liquefaction and storage there is sufficient precedent and technical knowledge in this country and the

U.S.A. to establish confidence in their successful application to natural gas. In the case of ocean transport, however, there is no precedent, and, so far as it is known, no ships have been built with insulated tanks for carrying fluids at sub-zero temperatures. Special ships have been built for carrying a wide range of chemicals some of which are contained in insulated tanks at temperatures above 200°F. Ships have also been built and operated for carrying heavier hydrocarbons such as propane and butane in the liquid form, but in these cases the liquids are carried at atmospheric temperature and at pressures up to 250 lb. per sq. in. gauge. The largest ship of this type now operating has a gross capacity of 7,300 tons. In all these ships the liquefied gas is carried in batteries of vertical pressure cylinders which are mounted within the existing hold spaces.

Layout of Tankers

In the case of normal oil tankers, the holds are divided by longitudinal bulkheads in order to minimize shifting of the cargo in rough weather, and it will be necessary to apply this principle to ocean-going ships carrying liquid methane. Oil tankers usually take ballast water in oil tanks when travelling light, but this would not be possible with the low-temperature insulated tanks required for methane. It would, therefore, be necessary for the ship to be designed on the lines of a dry cargo vessel with a double bottom and wing tanks that can be used for ballast. It would also be desirable in a liquid methane ship for the engines to be situated aft in order to obviate complications arising from the propeller tunnel passing through the after holds. Care will be necessary in the design to provide an effective system of purging, probably with nitrogen, in the insulation spaces around the liquid gas tanks in order to avoid any possible accumulations of gas and also to provide a dry atmosphere that will prevent the ingress of moisture. It will also be necessary to provide a circulation of water, oil or other suitable fluid in the double bottom and wing tanks in order to ensure that the inner steel plating of the ship's hull enclosing the insulated cold tanks is maintained at ambient temperature. Fire precautions and fire-fighting apparatus should be provided on the basis of a highly inflammable cargo similar to petroleum spirit. The fire hazards associated with liquid methane are, however, not considered to be worse than those associated with petroleum spirit.

As the specific gravity of liquid methane is only 0.42 (water = 1) the total cargo capacity in a ship of given size is considerably less than in an oil tanker. This can be offset to some extent by designing a deep ship or tanker on similar principles to a passenger vessel, but even under these conditions it will probably be necessary for the vessel to carry ballast to achieve satisfactory stability. This ballast could be in the form of oil so that the ship would carry dual cargo, with increased earning capacity.

It is known that ships designed for ocean transport may be subject to a considerable degree of distortion and deflection in heavy weather. A 500 ft. long ship may hog or sag as much as 6 in. in addition to a measurable degree of twisting. These factors should be taken into account when designing the low-temperature containers and arranging for their location within the insulated compartments. The accelerations of the ship in rolling and pitching are also of importance when designing the low-temperature tanks. Accelerations exceeding 1.0g have been known to occur and these would result in increasing the effective weight of the tanks and contents to double their normal value. Rolling accelerations are related to the 'stiffness' of the ship as determined by the metacentric height. In the case of a liquid methane carrier, it will be advantageous for the ship to have an easy roll associated with the low metacentric height. This would minimize the energy imparted to the liquid gas due to ship movement and thereby avoid excessive boil-off.

Many alternative basic designs have been suggested for liquid methane carriers embodying the principles set down above. These fall into one of three main types:

(*a*) Ships of double-hull construction containing independent insulated methane tanks arranged in groups within the holds. Alternatively, the cylindrical tanks may be placed horizontally within the ship's holds and along its axis.

(*b*) Ships of special design with the hull built integral with large insulated liquid methane tanks filling practically the entire cross-section of the hull, the insulated tanks being either of cylindrical form with axes parallel to that of the ship, or they could be large spherical tanks.

(*c*) Ships may be constructed with large insulated cold boxes filling the entire space of each hold. These cold boxes would be vapour-tight with steel walls insulated internally with balsa wood, foam glass or other suitable insulating material. Placed within these cold boxes would be clusters of tanks in special material (either stainless steel or aluminium) for containing the liquid methane. Each tank would be provided with its own liquid-filling and discharging connexions and a boil-off vapour line.

Of the alternative designs outlined, the last type appears to be the most promising since less space is wasted in insulation and it has distinct advantages from the point of view of safety. Should any leakage or spillage of liquid gas occur from the internal metal tanks it can be contained within the balsa-lined hold without contacting or damaging the hull structure. Indicating devices should be provided to give warning of any leakage from the internal metal containers and, if necessary, provision can be made to pump overboard any liquid collected within the balsa-lined hold space.

The boil-off gases from the ship's tanks can be dealt with in one of three ways: they can be vented to atmosphere at the mast, or they can be reliquefied by a small liquefaction plant, or they can be used as fuel for the ship's propulsion machinery.

If the third alternative is used, it so happens that the estimated boil-off rate of 0.3% to 0.4% of the ship's cargo per day would be sufficient to drive a ship at a speed varying from 15 to 17 knots. With this system, it will be necessary to leave sufficient liquid methane in the tanks for the ship's return voyage and this feature will also have the advantage of maintaining the tanks in the cold condition continuously.

Economic calculations indicate that it may be preferable to reliquefy the boil-off gas since the ship is required to carry ballast and this can be in the form of fuel oil which has a value sufficiently below that of the liquid methane to offset the capital and operating costs of the re-liquefaction plant.

The cost of operating such ships depends largely upon their size and, if the project is to be competitive with other systems of fuel transportation, it will eventually be necessary for ships of large size, in the 25,000 to 35,000 ton class, to be designed and built.

Economic Considerations

Quite apart from the broad conception that the successful importation of liquid methane would give the gas industry a greater long-term flexibility and a greater degree of independence, with all the attendant benefits, it is important that any project should show reasonable short-term economic promise. In this case, our yardstick for comparison is the cost of gas produced from oil, and the simple level of comparison is the price of the therm in the form of liquid gas and the therm in the form of oil. In both cases these prices will be made up of the cost of the work put into the material to land it in this country plus the price of the raw material at source.

In the case of oil, the main item of capital plant is the refinery, which may cost between £30,000 and £35,000 per mill. therms throughput of oil per annum compared with some £20,000 to £25,000 for the gas pre-treatment and liquefaction plant of similar thermal throughput. On the other hand, oil tankers cost some £20,000 per mill. therms per annum transported from the Caribbean to England, as compared with estimates up to £42,000 for liquid-gas tankers. Storage costs for the liquefied methane are also considerably higher than for oil, and in the overall comparison the total capital cost per therm of refined oil delivered is likely to be some 25% lower than for a therm of gas delivered. Labour costs for the two processes are likely to show a small advantage to gas liquefaction and the overall capital and operating costs are likely to be 1.5d. to 2d. per therm of oil against 1.2d. to 1.5d. per therm for liquefied gas.

Although the initial cost of the liquid-gas tanker may be about double that of the conventional oil tanker, the operating costs, including fuel, are likely to be only slightly greater in the case of the latter ships, and the comparative overall costs, including capital and operating expenses, would be approximately 1.5d. per therm for oil and 2.5d. per therm for gas transported to England from the Caribbean. The overall costs, therefore, for refining, storage and transportation of oil would be around 3.3d. per therm, whereas for purification, liquefac-

NU-SWIFT

The world's fastest and most reliable fire extinguishers

Complying with British Standard Code of Practice

(British Standard Code of Practice C.P. 402.401 (1951) is published on behalf of the Council for Codes of Practice for Buildings by the British Standards Institution.)

Universal (Royal Navy) Extinguisher Model 1301 for Class A fires
Air Foam Extinguisher Model 1400 - - - - - - Class B fires

Approved by the Fire Offices Committee

	FOC Ref. No.
Universal (Royal Navy) Extinguisher Model 1301 for - - - - - - - - - - - - - - -	Class A fires 104/6
Air Foam Extinguisher Model 1400 - - -	Class B fires 104/3
Auto (CTC) Extinguisher Model 1003 - -	Class C fires 104/5
Auto (Chloro-flash) Extinguisher Model 2003 - - - - - - - - - -	Class B & C fires 104/7

All these models comply with British Standard specifications, where these exist. No British standards exist for chlorobromomethane extinguishers or double-action nozzles like that of the Universal extinguisher. But special FOC approval has been given to these Nu-Swift features because of their increased efficiency.

Accepted by the London County Council

Consent granted under Sec. 20 of the London Building Acts (Amendment) Act 1930.

All Nu-Swift extinguishers that are approved by the Fire Offices Committee.

Why Nu-Swift are better:

Nu-Swift extinguishers are the only ones on the market to combine these essential advantages.

Immediate action—

instant pressure-charge operation eliminates waiting for a chemical action to build up pressure.

Quicker recharging—

all 2-gallon Nu-Swift extinguishers can be recharged and back in use in 30 seconds.

Standard system—

all Nu-Swift extinguishers are used in the commonsense upright position. There are distinctive colours for the models for different fire risks.

Greater reliability—

Nu-Swift pressure charges produce a pressure that is always exactly right for fire-fighting, never too great for safety. They will not leak, evaporate, or cause corrosion.

For extra safety in buildings new and old—specify Nu-Swift extinguishers

NU-SWIFT

Nu-Swift Ltd.,
25 Piccadilly, London, W.1
Telephone: REGent 5724
Telegrams:
NUSWIFT PICCY LONDON
Headquarters and works:
Elland, Yorkshire
Telephone: Elland 2852
Telegrams:
NUSWIFT ELLAND

And Now

A Standing Arrangement

Housewives everywhere will greet the appearance of the **NEW WORLD** *Seventy One T.T.*

BECAUSE

- **It has oven and hot-plate side by side at table top height**
- **It eliminates the necessity for stooping**
- **The oven can be placed either side of the hot-plate to suit layout of kitchen**
- **Cleaning is easy—it has a vitreous-enamelled stand**
- **It is very moderately priced**

The Seventy One T.T. has been produced in response to an insistent demand for a Table Top Cooker. It has many of the features of the **NEW WORLD** Seventy Five plus the storage rack for pots and pans underneath.

NEW WORLD

The most famous name in Gas Cookers

RADIATION GROUP SALES LTD., 7 STRATFORD PLACE, LONDON, W.1. TEL: MAYFAIR 6462

It's another NEW WORLD winner

PRODUCT OF Radiation Ltd.

it's a Six

There's no stopping Henry - he's out there belting the opposition - his aggression is getting results too! So will you - when you show 'em the "Six" - there's nothing better in cookers to-day.

BEST IN EVERY TEST

PARKINSON

RENOWN Six

THE PARKINSON STOVE CO. LTD. STECHFORD BIRMINGHAM 33

A Member of the Parkinson & Cowan Group

tion, storage and transportation of methane the cost is estimated to be about 4d. to 4.5d. per therm on very large-scale working. It is clear, therefore, that any advantage that liquid gas can show over oil delivered to this country must be founded on a lower cost of the raw material at source.

A proportion of the gas under consideration is produced in any case along with oil, and if no other outlet be available the gas must be flared to waste. The production costs of gas under these conditions are a matter of accountancy, but, taking the example of American oil and gas, an average price for oil at well-head is 4d. per therm, and even there, where the demand for gas is very high, the corresponding average price at well-head is less than 1.5d. per therm, and this includes only a small proportion of gas which would otherwise be flared.

The operating costs quoted for gas liquefaction and transportation are founded on estimates of possibilities, but it is suggested that the overall economic picture even on a short-term basis is sufficiently promising to merit the attempt to establish successful technical operation. Another possible economic attraction of the liquid natural gas scheme is the potential refrigeration value of the liquid methane when delivered. This could be used effectively in the production of cheap oxygen or other chemical processes requiring low temperatures and may be worth up to 1d. per therm of gas delivered. On the other hand, the possibilities of lower gas production costs by the importation and use of crude oil should not be forgotten.

It is of interest to speculate on the form that a typical liquid gas supply project could take for this country. The discharging marine terminal must be where deep water is available to take ships up to at least 35,000 ton capacity, and if possible these bases should be near to the centre of gas usage. For optimum economic operation, liquid-gas ships must operate on a base-load schedule and any provision of gas above base-load requirements must be catered for by storage or, if economics direct, by some other form of gas production.

The next problem is to determine whether the gas should be distributed at 1,000 B.Th.U. per cu.ft. or whether it should be transformed down to the present level of calorific value. The advantages to distribution costs will favour distribution at 1,000 B.Th.U. per cu.ft., and there will be no loss of energy which accompanies transformation down from 1,000 to 500 B.Th.U. per cu.ft. On the other hand, supply at 1,000 B.Th.U. per cu.ft. will require the alteration of each individual customer's appliance to operate on high-calorific value gas and this may cost from £5 to £10 per customer.

It is obvious that any introduction of liquid methane must come in gradually, starting on the basis of a small ship with the possibility of increasing to base-load operation. In the early stages, therefore, the gas would have to be transformed until a sufficient degree of reliability of supply could be established and conversion be made later to high B.Th.U. operation. Such changes have been effected with success in America, and the attendant advantages in the costs of distribution are considerable.

The case may be considered where it is desired to supply the equivalent of 200 mill. cu.ft. per day of 500 B.Th.U. per cu.ft. base-load gas to London from Venezuela. A ship to carry 15,000 tons of liquid natural gas would require approximately 28 days for the round trip and would deliver at an average rate equivalent to 50 mill. cu.ft. of transformed 500 B.Th.U. per cu.ft. gas per day. A minimum of four ships of this size would thus be required, and storage tanks of approximately 25,000 tons capacity would be needed at the sending and receiving ports. The gas pretreatment and liquefaction plants would have to be rated at 110 mill. cu.ft. of natural gas per day, and preliminary estimates show that the total capital investment for the whole project, including jetties, reforming and ancillary equipment, would be in the region of £40 mill. This compares quite reasonably with the capital investment necessary for gas-production and purification plant of conventional design.

DISCUSSION

Mr. William Wood Prince (President of The Union Stock Yard & Transit Co., of Chicago) said it was a great pleasure and a singular honour to have been asked to open the comments on the 'excellent and intriguing' paper presented by Dr. Burns and Mr. Clark. It seemed to be a most truthful and accurate summary of the situation as regards the liquefaction and transportation of natural gas. He proposed to speak about the experience and thinking of Constock, a partnership formed by the Continental Oil Company and the Chicago Stock Yards.

There was no doubt that natural gas, which was currently being wasted in parts of this world, would be brought economically to those parts of the world where it could be marketed and put to use. The art of liquefying gases was well established, although large volumes did present new problems. The art of changing the calorific value of gas, likewise, was well-established, and the storage of liquids of cold temperature had been well achieved and its principles established. There remained, therefore, the question of transportation to prove successful and economical. Basically, this meant containing the gas in the hold of a ship, using the maximum space possible for the gas itself.

The first factor to be considered must be safety, and the crux of the matter was the insulation. How could a disaster such as that at Cleveland have been avoided was the first question to be asked. Leaving the composition of the inner liner for the moment, one thing would appear certain, that if the insulation itself had been a barrier capable of containing the liquid for a period of time, safety could have been obtained. Thus, working with the American Petroleum Institute and the United States Coast Guard, Constock had set up minimum standards for this insulation:

1. Ship structure adjacent to cargo tanks to be maintained at a temperature differential of not more than 10°F. below ambient temperatures.
2. Cargo tanks and insulation assembly to be capable of withstanding a fire exposure of 1,200°F. for a period of six hours in order that the contents may be safely discharged without failure of the insulation.
3. Installation of tank and arrangement of insulation to be such as to permit inspection of one side of bulkhead structure and tank plating adjacent to tank.
4. Combustible insulation or insulation having a melting point of not less than 300°F. may be used provided it is protected on the outside by approved combustible insulation or other acceptable methods to the extent necessary to meet the requirements of item 2 above.
5. Insulation to be resistant to the action of the lading and to be structurally stable.
6. Where insulation is in contact with the product, the arrangement of material must be proven by acceptable tests to be suitable for the lading at the service temperature.

In addition to these minimum requirements, Constock felt it highly desirable that the insulation as installed should be liquid-tight, that is, capable itself of containing the cargo when subjected to movements and stresses which might be encountered in sea duty.

Also it was desirable, though not mandatory, that the insulation be waterproof, vermin-proof, and not attacked by rot or fungus, and be non-toxic to humans.

In the search for such an insulating material it had been concluded that at present Balsa Wood alone could be made to satisfy these standards. There might be, and in all probability would be, developed an inorganic material that would satisfy these requirements and be more easily applied, but at the moment none was known.

Liquefaction Barge

A barge with five tanks had been constructed, each capable of holding 22 mill. cu.ft. of gas in liquid form. Two of these tanks had been completed with balsa wood and were now undergoing tests. At the same time, a liquefaction barge had been constructed designed to liquefy between 7 and 9 mill. cu.ft. of gas a day. This barge was also undergoing test.

Continuous liquefaction at about 60% of capacity had been achieved. The experience of the balsa wood lining had been interesting. The lining is 1 ft. thick. The ambient temperature between the outside shell of ordinary plate steel and the atmosphere was between 5° and 6° over the greater part of the area.

There had developed, however, two areas in which the ambient fell to 25° below the outside, and one area of a few feet in diameter where the outside tank actually dropped below zero Fahrenheit. The surprising thing about this particular area (and yet a gratifying one) was that this low temperature took several weeks to develop, revealing, therefore, that any danger which developed could be spotted beforehand and proper precautions taken.

To sum up the current status then, it had been demonstrated, firstly, that large-scale liquefaction could be accomplished, but that to do so was not simply a question of enlarging conventional small-scale equipment as new conditions arose with the larger volume of gas. Secondly, it had been demonstrated that a balsa wood tank with an inner lining could be constructed so that safety could be maintained through proper precautionary measures. So, while it could not be said at this stage that the balsa wood alone was adequate there was no doubt that with an inner lining of aluminium or alloyed steel complete safety could be guaranteed to the cargo.

In conclusion he would like to mention the dominant factor, namely capital. Somewhere between 12s. and 15s. per 1,000 cu.ft. of gas delivered annually was required in capital expenditures. On the other hand, the ratio of sales to capital was so low that it would probably take in the neighbourhood of two years to turn the capital over once. This lead to the necessity of long-term contracts and a high profit margin in relation to sales. This, in turn, demanded the closest co-operation and confidence between all of the interests involved in bringing this fuel to market.

The President thanked Mr. Wood Prince for his 'brilliant exposition.' It gave point to what Dr. Gummert had written in the introduction to his paper: 'When you have been working for long enough on a problem it does not matter much whether you began as a technical or a business man.'

Methane Development Inadequate

Professor M. B. Donald said that although it is some 11 years since a methane-driven motor coach had come down from Lincolnshire to London to demonstrate its possibilities, the proper development and use of methane was still not adequate.

What was the reason for this very slow development? Was it possibly largely due to the disastrous explosion in Cleveland? The whole of chemical engineering experience went to show that hazards of this nature would not stop a project being developed if sufficient care was taken to introduce and maintain efficient safety precautions.

Was one of the major hazards of methane storage the trouble due to the brittleness of the metals used as containers at the very low temperature encountered in use? It would seem that any research directed towards these requirements would be well worth while. One of the problems was to decide whether the Izod or Charpy method of testing notch brittleness gave the best answers. It should be quite possible to relate them by extension of the researches on the transmission of shock waves in solids.

Then there was the question of developing improved methods of testing at the actual temperatures employed in practice. The tacit assumption that experiments performed at room temperature would give an indication of their behaviour under these very cold conditions was a very dangerous one. The final requirement was the very tedious one of testing a large number of materials, non-metallic as well as metallic, in order to select the most suitable.

A second point was the question of sulphur compounds which occur in significant quantity, for example, in the Middle East crude. The separation of these compounds by simply physical means such as distillation should be comparatively simple if the suitable physico-chemical measurements were available, but this again was a large gap in our knowledge which required considerable research.

Finally, he asked the authors whether the question of using the boil-off gases to provide fuel for a secondary refrigeration circuit external to the container to cut down evaporation had been considered. It should provide, to some extent, a self-regulating device.

Storage Problems

Dr. N. Booth (The British Oxygen Co., Ltd.) said he would like to comment on one or two of the liquefaction and storage problems in a liquid methane scheme since his Company had given some attention to these aspects of the matter.

Firstly, with regard to liquefaction cycles, there was no doubt that the cascade cycle offered the highest thermodynamic efficiency, and it might even be that in practice its power consumption was lower than that of alternative cycles. However, this advantage might well be offset by the greater complexity of the plant which might be more costly to purchase and to install, and also would probably be more costly to maintain. It might be found when specific schemes were worked out that a plant based on the Heylandt cycle, i.e., a combination of Joule-Thomson expansion and realisation of external work, would prove to be the most economic when all factors were taken into account. The authors had pointed out that on locations where fuel was cheap the power consumption was of reduced importance. On such remote sites simplicity of plant might be more important than it would be elsewhere.

Turning to the question of cost of liquefaction, referred to on pages 18 and 19, one was on more treacherous ground for much depended on what assumptions were made and what was included in the cost figures. Assuming that methane was available at approximately atmospheric pressure at the liquefaction location and that the cost figure included all materials, labour, supervision, power, services and depreciation of the plant over ten years, the figure of 1.2d.-1.5d. per therm was rather low. Even assuming a well-head pressure of several hundred pounds these figures were somewhat optimistic.

It was important to remember in a liquid methane project that one was transporting not only a source of fuel but also a source of refrigeration, and of low temperature refrigeration at that. The authors had quite rightly drawn attention on p. 20 to the possibility of using this refrigeration. On a modern tonnage plant for making gaseous oxygen the pressure of operation was so low that it was doubtful if much use could be made of a refrigerant like liquid methane. On the other hand on a plant designed to provide liquid oxygen the value of liquid methane would be considerable, although he would not like to comment on whether it would be worth as much as 1d. per therm.

Refrigeration

In making use of the refrigeration to produce liquid oxygen it would probably be necessary on safety grounds to transfer the cold from methane to air by way of a special gas, such as nitrogen or argon.

Finally, on the question of tanks, the authors refer to the failure of the tank at Cleveland which resulted in such a disastrous fire. This was a very unusual happening and, with proper attention to design, should not occur again. Liquid oxygen had been stored over many years on many industrial sites in several countries without incident. It was true that the scale has usually been somewhat lower than that at Cleveland, but the same principles were applicable.

Mr. E. S. Squire said that on the whole the authors of the paper had not underestimated the problems associated with the liquefaction, storage, and transport of liquefied methane and had given a fair overall picture of the position of this subject.

The costs of production and transport quoted were too low for liquefied methane and a detailed analysis of similar assessments usually showed that insufficient capital investment had been allowed for standby plant and the provision of the services and amenities that were necessary for the operation of such a project under the conditions that existed in gas-producing areas, especially in the Middle East.

It was difficult to understand why all the writers on this subject, even when dealing with the natural gases from the Middle East, thought in terms of liquefying methane. More than 50% by weight of Middle East gases consisted of hydrocarbons heavier than methane, and in this respect differed very much from most of the natural gas in the United States. By the normal method of separating the gas from the crude oil a rough separation into light and heavier hydrocarbons was made. It had been very interesting therefore to see that the authors on p. 5 of their paper indicated that 'propane and butane are technically almost ideal sources of hydrocarbons to the gas industry' and on p. 8 said that 'from the technical aspect it is

REF. No. IND/FD/89

HUWOOD Conveyors

HUWOOD

In growing demand in the GAS and allied Industries

The best form of short distance transport

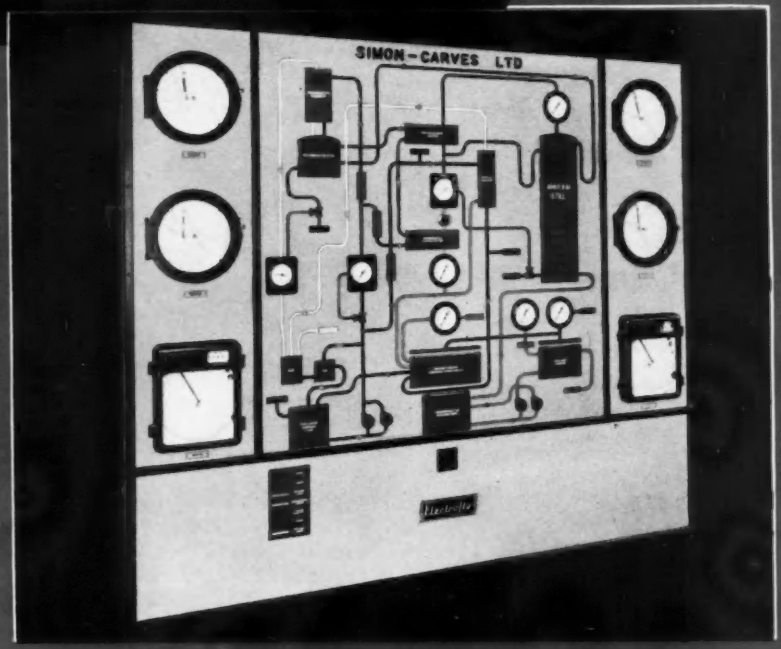
HUGH WOOD & CO., LTD., GATESHEAD-ON-TYNE, 11.

Graphic Panels

manufactured

by

ELECTROFLO



Complete Automatic Control and instrumentation of the new effluent treatment plant

at

STOCKPORT GASWORKS

NORTH WESTERN GAS BOARD

Photograph by courtesy of the North Western Gas Board and Messrs. Simon Carves Ltd.

ELECTROFLO METERS COMPANY, LTD.

Head Office: Abbey Road, Park Royal, London, N.W.10.
Factories: Park Royal, London and Maryport, Cumberland.
Telephone: ELGar 7641 Telegrams and Cables: Elflometa, Harles, London.

A Manufacturing Organisation devoted to the DESIGN, PRODUCTION, INSTALLATION & SERVICING of industrial instrumentation and automatic control of all types of power and processing plants.

Write for Cat. 40 "Instruments for the Gas Industries"

not a matter of primary importance whether the heavier hydrocarbons such as propane and butane are removed from the gas prior to liquefaction.'

The logical approach to liquefaction of natural gas, especially gas produced in the Middle East, would be first to liquefy the streams containing a high proportion of the heavier hydrocarbons and to deal with the lighter hydrocarbons only when the demand made this necessary.

Dealing with gases from the Kuwait field in this way, at current rates of crude oil production over 500,000 tons per annum equivalent to 800,000 therms per day could be liquefied and stored under atmospheric pressure at a temperature of −85°F. with a power consumption on the compressors of less than one half horsepower per hour per therm.

One and a half million tons per annum, equivalent to 2 mill. therms a day, could be liquefied and stored at a temperature of −120°F. with a power consumption on the compressors of 0.8 horsepower per hour per therm.

Up to this particular stage in the development of such a scheme the liquefaction could be carried out using propane only as an external refrigerant, but in the later stages propane with ethane or ethylene in cascade would be necessary.

If all the gas was treated something like 4 mill. tons per annum could be liquefied but the storage temperature would now be −240°F. and the power consumption 1.33 horsepower hours per therm.

For the liquefaction of methane the power consumption was variously quoted as from approximately 1.8-2.5 horsepower hours per therm. So it would be seen that in the method suggested there were a number of advantages: First of all, the ability to store the material at very much higher temperatures in the early stages before going on to the lighter gases, the cost of liquefaction was very much lower, and a further advantage was that the liquefied product would have a calorific value of 1.2 to 1.27 therms per gal. at storage temperature compared with a little over 1.0 therm per gal. for methane so that the transport costs will be correspondingly lower.

Heavier Hydrocarbons

If the gas industry could accept these heavier hydrocarbons there could be no doubt that the logical way to develop the project would be to liquefy the heavier hydrocarbons first leaving the lighter and more difficult hydrocarbons to be dealt with at the appropriate time.

The authors emphasized the great technical problems associated with sea transport of liquefied natural gas but they might have under-estimated the likely cost of transport, assuming the technical difficulties could be overcome, as no doubt they could. At the top of p. 20 they quoted a transport cost of 1.5d. per therm for oil and 2.5d. per therm for gas transported to England from the Caribbean; they presumably suggested, therefore, that the cost of transporting methane would be about 1.66 times the cost of oil.

A gallon of methane at storage temperature had a calorific value of just over a therm compared with 1.6 therms for fuel oil. When account was taken of the space occupied by lagging, free space for ventilation, and so on, the pay load in therms for a given sized ship in cubic feet of methane would probably be less than one half of that of oil. Even if the capital cost of the ship was the same this would make the transport cost double that of oil. The capital cost of the ship, however, would be considerably higher and bearing in mind also that some liquid methane would have to be carried on the return journey to avoid violent temperature fluctuations it was possible that the transport costs will be 2½ to 3 times that of a normal fuel oil cargo.

CONVERSATION PIECE

This cheerful group includes Messrs. W. D. King, A. Forshaw, T. V. Garrud, N. R. Junkison, L. W. Andrew, and J. A. Prigg.

There to see the Duke's visit were Miss and Mrs. Logan, of New South Wales, Mrs. Symon, Mrs. Curtis, Mrs. Ronald Logan, and Mrs. Battersby.

Pictured here are Messrs. N. R. Junkison, R. F. Hayman and E. W. B. Dunning.

Abstract of I.G.E. Communication 483

Problems of the Long Distance Transmission of Gas in Germany

By Dr. F. GUMMERT,

Member of the Directorate of the Ruhrgas, Aktiengesellschaft, Essen.

THE production of gas in Western Germany in 1954 totalled about 12,800 milliard cu. metres, of which some 12,387 milliard were consumed. The great majority of the gas produced was made at colliery and blast furnace coke ovens, namely, 80%, and only 18.5% from gasworks. The remaining 2.5% is imported, mostly from the Saar. The great majority of coke ovens are at collieries, in fact, 253, compared with 22 at blast furnace plants. Of the 12,387 milliard cu. metres* consumed, 10,074 milliard were consumed by industry, 1,814 by domestic consumers, and the balance, 0.599 milliard, by miscellaneous consumers, including street lighting, foreign countries and the Russian Zone.

If the gas consumptions of other countries are equated to the same conditions of measurement as that of Western Germany, namely, a C.V. of 4,300 kcal. per N cu. metres at 0°C. and 760 mm., America heads the list with 356.0 milliard cu. metres followed by Great Britain with 15.456 milliard, Germany 12.387 milliard, France 4.580 milliard, and Belgium and the Netherlands together at 2.996 milliard.

Compared with Great Britain where the distribution of coal is fairly widespread, the coal in Western Germany is confined to the Ruhr, and it is here that the great majority of the coke oven plants are concentrated. Consequently, of the coke oven gas available, 92% comes from this area and the remaining 8% from around Aachen.

About 45% of the total gas consumed by industry is supplied direct, for example, to the Bochumer Verein and other large steelworks in the Ruhr, but by far the greater part, namely, 66% of the total consumption, is supplied to the long distance supply companies for redistribution.

Ruhrgas A.G. is the most important of the supply companies, the shareholders of which include the Ruhr coal companies and the Thyssen gas and water works. Ruhrgas A.G. does not sell directly to householders, but to local gasworks and directly to industry. Out of the 5,556 milliard cu. metres handled by the long distance supply companies, 1,578 milliard are supplied to the local gasworks and 4,229 milliard cu. metres direct to industry.

Up to 1939, the data apply to the whole of Germany, and from 1949 onwards to Western Germany alone. For 1954, the figure is 260 cu. metres *per capita*, as compared with about 320 cu. metres in England, as the British domestic consumptions per household meter are far higher than in Germany. From 1860 to 1920, consumption increased fairly steadily, because during this period there occurred the big change over from gas for lighting to gas for cooking and hot water. A sharp increase from 1925 onwards—a slight decrease about 1930, the time of the economic crisis—but then again a steep increase up to 1940; finally, after the second world war the consumption in 1924 of 50 cu. metres *per capita* had in 30 years increased five times to 260 cu. metres.

Ruhrgas Founded

As early as the beginning of this century colliery coke ovens in the Ruhr began to supply gas to one or other nearby town, but the great increase in the use of coke oven gas, however, set in only after the First World War. There were some 150 coking plants in the Ruhr district, but all of them were old fashioned and more or less worked out, but renewal could not be taken in hand until after the end of the French occupation of the Ruhr and after the end of the depreciation of our currency, that is, after 1923. It was then decided to build about 50 large central coking plants which would receive coal from various pits, instead of the 150 old small plants. Thanks to the progress in technical development, double or three times the amounts of gas produced before by local gasworks were to be expected and that was the reason why the Ruhrgas A.G. was founded, to create a common supply grid in order to avoid a confusion of crossing mains from various collieries to the various centres of consumption, and to utilize the amounts of gas to be expected in the best possible way.

To dispose of this extra gas, plans were made at the same time to supply part of it directly to iron and steel works and to chemical works, including those producing nitrogen, and also to new glass works in the Ruhr area.

In the course of time, we have seen at many places in the Ruhr area the development of something that we call 'Verbundwirtschaft' (integration), that is to say, a close interconnection between the coal, iron and chemical industries. As an example, I will quote the 'Gasverbund' in the Oberhausen area. Here we have a coke oven plant; 26% of the coke oven gas produced is used to heat the coke ovens, 14% is supplied to the Ruhrgas grid system, 46% goes in this instance to a chemical works, and 14% to a steel works and rolling mill. The latter is supplied with residual gas by the chemical works. In addition to the coke oven gas just mentioned, it also receives blast furnace gas. The other, and greater, part of the blast furnace gas is used for heating the coke ovens. This is a relatively simple system. The object is always the same, namely, to make the best possible use of different gases by mutual exchange.

It seems to me that this 'Verbundwirtschaft,' this system of integrated industries, is a third characteristic feature of the gas economy in Germany.

Long-Distance Grid

The appearance of coke oven gas has not superseded the gas from gasworks for domestic use. There has been an increase both in production and in consumption, as industry has come more and more to realize that the use of gas offers great advantages and has consumed to an ever-growing extent the great amounts of coke oven gas produced in the course of the modernization of the coking plants. About one-half of the additional amounts that have been available since 1925 is long-distance supply gas in the proper sense, the other half is gas supplied by the coke ovens without long-distance mains.

A pre-requisite for the development of long-distance gas supply was the building of a long-distance gas grid. (A diagram showed the mains installed in the period from about 1925 to 1954.) The distance from Essen to Hanover, or from Essen to Mannheim, is approximately 250 kilometres (156 miles).

The part east and south of Hanover comprises the grid system of Ferngasgesellschaft Salzgitter, a subsidiary company of Aktiengesellschaft für Berg- und Hüttenbetriebe (the former Reichswerke).

This Company owns big iron and steel works east of Hanover which obtain their coal from the Ruhr and produce coke and gas in their own coke ovens. From here, a main of about 250 km. length was laid to Berlin before the second world war but this has now been practically cut off by the separation of the zones of occupation.

In the south, the mains in the Saar district were shown. A large part of the gas produced there goes to the neighbouring districts of Western Germany. The main from the Aachen area to Cologne belongs to the Thyssen gas and water works. Part of the remaining system, for example, the main Duisburg—

* 1 Nm^3 (0°C., 760 mm., dry) at 4,300 Kcal.
= 37.22 $ft.^3$ (60°F., 30 in., dry) at 458.6 B.Th.U.
12.387 milliard Nm^3 = 461.044 × 10^9 cu. ft. at 458.6 B.Th.U.

Cologne—Bonn, and the grid in Krefeld, belongs jointly to the Thyssen gas and water works and to Ruhrgas A.G. In addition, the diagram showed branch mains owned by companies which obtain their gas for the most part in the form of long-distance supply gas, as, for example, the Westfälische Ferngasgesellschaft and Vereinige Elektrizitätswerke Westfalen.

The long-distance mains are welded steel pipes about 300 to 800 mm. (11.8 to 31.5 in.) in diameter. The compressor stations, purification plants and gasholders included in the grid belong partly to the collieries, partly to the long-distance supply gas companies.

Gas supplied by Ruhrgas A.G. to different groups of consumers, from 1928 to 1955, shows at first a rapid increase up to about the end of the war and then the catastrophe in 1945. Since then development has gone from only 300 mill. cu. metres in 1945 up to a consumption of 4,576 mill. cu. metres in 1955. The increasing hunger for gas of the various consumers developed in the same measure as the repair, increase in production and new construction of coking plants.

To meet peak requirements there are, in the first place, holders which are filled over the week-ends in order to meet the increased demand on working days. The whole long-distance grid is also brought up to high pressure over the week-end, thus itself acting as a kind of large gasholder, and this high pressure generally falls off considerably in the course of the week. For short periods, surplus quantities of gas are used in most cases as boiler fuel instead of coal at the pits. In order to meet peak demand in the winter months recourse is had in the first place to producers using coke. At the moment, Ruhrgas A.G. disposes of a producer capacity of approximately 6.5 mill. cu. metres at 4,300 kcal., per day, but this gas is more expensive than the average selling price of the Company.

Prospects

As in other countries, so in Germany, estimates have been made up to 1965, most recently even as far ahead as 1975. They all agree in predicting also in Germany great possibilities of development for gas. It is at present calculated that gas supplies will double in the course of the next ten years. With all reservations as to such predictions over long periods, it can yet be said that such an estimate for Western Germany was already made in 1949, with the result that gas supplies, which then amounted to approximately 9 milliard cu. metres per year, might be expected to be doubled by 1960. At the half-decade, in 1955 gas supplies in Western Germany were about 14.5 milliard cu. metres, that is about 60% more than in 1950. For the last five years, this means an average increase of 12% per year against a rate of increase of 7 to 8% per year calculated in the estimates of 1949. It would appear, therefore, not unduly optimistic to expect a rate of increase of 6 to 7% also for the coming years.

Germany is a coal country, and the production of gas on the basis of coal will therefore remain the cornerstone of the supply system. There are, it is true, a number of local gasworks which are making great efforts to increase their capacity by enlarging their plant and also by using liquefied petroleum gas and by erecting new installations to produce gas not only from coal, but also from oil. Whatever may be the importance of such a plant, especially for meeting peak demands, an overall increase of gas production in the gas industry as a whole will only be possible, in Germany at least, by increasing production on the basis of coal. This applies especially to the long-distance gas supply industry the structure of which is very closely connected with coal. What has Ruhrgas A.G. been doing in this respect?

Considerable reserves lie in the gas used for the heating of coke ovens. In 1954 not less than 4.5 milliard cu. metres of high-quality coke oven gas was used for heating the coke ovens. It is admitted that for technical and geographical reasons it will hardly ever be possible for the total amount of rich coke oven gas, now used for heating coke ovens, to be replaced by other gases. However, it should be possible to replace about 2 milliard cu. metres of coke oven gas used in this way by producing lean gas in producers at coking plants to only a limited extent, because of the comparatively high cost involved. In addition, it must be borne in mind that it is necessary first to produce coke from high grade bituminous coal, which is available only in limited quantities.

The first way chosen by the Ruhrgas Company was to produce lean gas suitable for heating coke ovens not indirectly from coke, but directly from coal of inferior quality and high ash content which is difficult to sell. A first trial plant of this kind, a so-called vortex-chamber ('Wirbelkammer'), has been started up at a coking plant in the Ruhr, and results are quite satisfactory. Up to now, the plant has been working mostly to cover part of the peak demand in winter. It has a daily capacity of about 500,000 cu. metres of lean gas of about 1,000 kcal. per cu. metres which is produced from a coal dust-air mixture. These 500,000 cu. metres of lean gas can be used to replace more than 100,000 cu. metres per day of coke oven gas of 4,300 kcal. per cu. metre. About 100 tons of coal dust are required for the production of this amount of lean gas.

Complete Gasification

Further experiments have been carried out on the complete gasification of coal with the object of producing a gas of high calorific value which is suitable for being directly supplied over long distances. These experiments, which had already started before 1939, interrupted by the war, were resumed shortly afterwards and have given practical results. The point was to find a method giving the highest possible yield of gas per ton of coal with only gas as final product, to meet the situation on the gas market, without having to market other products. It had to be borne in mind that high-grade bituminous coal had to be reserved mainly for the production of coke required by the iron and steel industry. This was not only in the interest of the mining industry and of the iron and steel industry, but in ours as well as a long-distance gas supply company, since coke oven gas is the main pillar of long-distance gas supply and will remain so in the future. The point, therefore, was to have recourse to grades of coal that are unsuitable for coking and are besides saleable only with difficulty.

At the end of 1955, the first big gasworks of this type came into operation at Dorsten. Unwashed gas coal is processed almost completely into high-quality gas, without the production of coke. The plant is designed for a capacity of up to 500 mill. cu. metres at 4,300 kcal., per year, requiring up to 335,000 tons of coal. This corresponds to more than 10% of the present amount of gas supplied by the Ruhrgas A.G. in a year.

A coking plant of the same capacity—admittedly with the simultaneous production of coke—would require four to five times this amount of coking coal.

The colliery in the immediate neighbourhood of the plant supplies it with coal, steam, and also compressed air from which oxygen is produced in the works itself. This oxygen plant is one of the largest in Europe, having a daily output of 250,000 cu. metres of oxygen. The calorific value of the gas produced in this high-pressure gasification of coal is 3,900 kcal. per cu. metre, which is slightly less than the standard for long-distance supply gas. It is therefore improved by adding natural gas from the Bentheim field supplied through a pipeline of 80 km. length.

The fact that in this plant gas is produced for the sake of gas, is also clearly indicated by a comparison of an analysis of the revenue for the high-pressure gasification of coal, on the one hand, and for coke ovens on the other. In the latter, the coke accounts for approximately 71% of the value, gas only about 17%; in the high-pressure gasification of coal, 79% is for gas and 21% for valuable substances such as crude benzine, carbolic oil, fuel oil, pitch and ammonia.

Boiler Firing

Considerable technical difficulties were encountered when carrying into practice research work done in Eastern Germany regarding the pre-carbonization of coal prior to firing it under the boilers of electric power stations.

This process involves a dual production, since not only is gas produced, but mainly electrical power. Electric power and gas are two forms of energy the market trends of which are parallel, so that most probably there will not be any difficulty arising from demand developing in different directions. In the field of electric power supply, too, rates of increase of 6 to 7% per year are expected.

The problems relating to increasing gas production are not, however, the only ones that have to be dealt with by the long-distance gas supply industry in Germany. We have to consider particularly the seasonal variations especially the winter peaks. Not least of the solutions to the problem of these peaks is the series of additional plants planned or already erected by a number of gasworks for producing gas from oil and oil pro-

ducts. Already during the first months after starting up the high-pressure gasification plant we were faced with the necessity of testing this flexibility. Several times, the production of this plant could be considerably increased or decreased within a few hours. It is obvious, however, that every effort must be directed towards continuous and steady running of the plant throughout the year, not least with a view to the operational cost. Hence, it must be one of the major aims of the long-distance gas supply industry to compensate seasonal variations in consumption not only by measures affecting the production of gas, but in addition by measures in connection with gas storage.

DISCUSSION

Mr. J. H. Dyde, Deputy Chairman, Eastern Gas Board, said that Dr. Gummert had begun by giving a survey of the development of the gas industry in Western Germany to the present day, and it was natural to make comparison with our own development. At once it could be seen how entirely different were the structural patterns that have emerged.

The first main points of difference related to gas production. In Western Germany 80% of the gas available for general distribution came from coking plants, 90% of the coke ovens being at the collieries—in other words, pit-head production. Practically the whole of the remaining 20% came from local, mostly municipal, gasworks. The corresponding figures of gas availability for the British Gas Industry were 13% from the coke ovens of the National Coal Board and other independently owned coking plants, the remaining 87% being produced in the gasworks of the 12 area boards. The second concerns gas utilization. In Western Germany 81% was used by industry compared with 27% distributed by British gas boards for the same purpose. The third point of difference, which was not a statistical one but a characteristic of gas economy, was the highly developed system which the author termed 'Verbundwirtschaft'—an integration of industries producing and consuming gas. Little, he believed, could be found in our industrial planning of the past of this form of integration, but with the increased use of energy in all its forms and the greatly increased cost of that energy, the obvious advantages of such systems had begun to emerge in our industrial economy. There was much to learn from German experience in this regard. There was, however, a recent example of 'Gasverbund' in Wales, which would no doubt be referred to by Mr. Edwards.

Development of Potentialities

Logical explanations for these three major differences could be found in history, geography, and the distribution of natural resources. In the industrialization of Germany, which did not really commence until after 1870, the Germans were able to benefit by some of the mistakes which we had made as pioneers in the industrial field. Nature was kind to them insofar as it had placed the major part of their mineral resources in one rich and extensive coalfield of the Ruhr, with the Sieg-Lahn ores close at hand, and laid that magnificent waterway, the Rhine, through the entire mineral belt. While envying this natural configuration of resources, we must give all credit to the manner in which the potentialities were developed.

In contrast, our own mineral resources were patchy and widely distributed, and it was natural that our heavy industries, iron and steel, should develop in those places where coking coals were available and port facilities at hand for the receipt of high grade ore. Hence the development of the Tyne, Teeside, South Wales and Clyde areas. This picture had changed somewhat in recent years with the exploitation of lower grade home mined ore to give rise to the inland steel production of the Midlands. It followed that the gas boards covering the industrial areas had the greatest intake of coke oven gas and the highest industrial sales.

Industrial Comparison

When comparing industrial gas sales in Western Germany with those in the British gas industry, it must be remembered that our coke oven industry supplied only its surplus gas to the British gas boards and an appreciable quantity was used for internal industrial purposes, particularly where the ovens were owned and operated by steel companies. Figures derived from the *Ministry of Fuel and Power Statistical Digest*, 1954, indicated that of the gas produced by coke ovens external to the gas industry 42% was used at the coke ovens themselves, mostly for oven heating; 31% was used for industrial purposes, mostly in steelworks; 25% was sold to the gas boards; and the final 2% was burnt to waste or unaccounted for. If this industrial gas consumption was added to that sold by the nationalised gas industry for the same purpose, the comparison with German industrial sales becomes much more realistic.

In this connection the author himself had stated that national figures could easily be misleading. He had been a prime mover in the setting up of a committee of the International Gas Union to standardize and collate international gas statistics, and which was shortly to produce its first report.

Dr. Gummert did not regard the doubling of gas supplies in the next ten years as at all optimistic; indeed current trends suggested it would be higher. This was rather more optimistic than our own forecast, but we had advanced much further already in our consumption *per capita*. Again, the figures quoted by Dr. Gummert were in regard to Western Germany, and there was no direct comparison with the former German Reich. Indeed, he wondered how much was still rehabilitation.

The author had said that the additional gas would be produced, first, by further liberation of high quality coke oven gas by firing ovens with lean gas produced directly from inferior quality coals. He had seen the vortex chamber process for gasifying these inferior coals at work. As a first commercial unit it was impressive, and what had astounded him was the rapid transition from laboratory to pilot plant and then to commercial unit. Some difficulties had, he believed, been experienced in employing the new techniques involved. Dr. Gummert now put it forward as an established process, and no doubt further improvements would follow.

Secondly, there was the development of high pressure gasification of coals unsuitable for coking, and the Lurgi plant at Dorsten, which he calculated to have a rating of about 40 mill. cu.ft. a day, with some enrichment by natural gas from the Bentheim fields, which was a sizeable project by any standard.

Our research people knew the Lurgi system well, and were working on improvements in design which should lead to considerable economies, but meanwhile time was passing, and a limited commercial achievement today was perhaps worth more than something nearer perfection tomorrow.

Both these aims would remain common to our two industries as long as coal continued to be the basic raw material of gas production, but there was some divergence in our industry's future plans insofar as we were placing greater emphasis on the gasification of petroleum products.

Grid Development

Mr. E. M. Edwards (Wales Gas Board) said that although there were differences between circumstances in the Ruhr and the industrial areas of Wales, especially in the coal, coke and oil price ratios, the methods adopted in Germany were of particular interest to him in view of the gas grid developments in North and South Wales. Naturally, the answers to the problems would be affected by these differences. The development of the two major grids would mean that by 1957 approximately 96% of the gas distributed by the Board's 105 gas undertakings, serving an area of about 8,000 sq. miles, would be handled by the two grids. Further developments would increase this figure to 99.5%. The difficulty was to decide what to do about the 0.5%! By the end of this summer 450 miles of grid mains would be in operation.

In the areas of concentrated demand the economic pumping pressures ranged up to 30 lb. per sq. in. The volume-distance relationship for less densely populated areas led to mains of smaller diameter designed for eventual maximum operating pressures of 200-250 lb. per sq. in.

He had recently had an opportunity of investigating the effect upon gas pro-

duction costs and long-distance transmission costs of the advances that have taken place during the last 20 years in capital costs of production and transmitting plant and pipe lines, together with variations in material and operating costs. A survey of 20 years was most revealing. Power costs for compression had advanced by 75%, whereas coal transport costs were now three times those of 1935. Steel pipes and labour had advanced to a much lesser extent than had the capital costs of gas production plants, especially the smaller plants. The broad conclusion was that the economic gas transmitting distances were continually increasing. The capital costs of various types of plant were altering. It was most important for us to realize that power costs were not advancing as fast as capital costs. If that was accepted, it meant that we were tending to go forward into a period of smaller diameter mains and higher pumping pressures.

Gas from Oil

The importance to the gas industry of accelerating the development of gasification processes producing gas at high pressures from coal or oil was of paramount importance—he meant plant that initially would be used for producing gas from oil, but if the international situation changed or world markets went against us, the plant could be adapted to use our own natural fuel.

With colleagues from other gas boards, an investigation had recently been concluded of the economics of the large-scale production of gas from oil and oil products, taking as the basis a new station designed to produce 50 mill. cu.ft. per day of 500 B.Th.U. gas. With gas delivered into the system at a process pressure of 300 lb. per sq. in., the inclusive transmission costs for 50 mill. cu.ft. per day for 85 miles would be about 0.3 pence per therm, and for 130 miles about 0.5 pence per therm.

The development of underground storage referred to by Dr. Gummert could become important in this country. When the Gas Industry Productivity Team visited the U.S.A. they were told of a difficulty experienced when manufactured gas was stored underground. In this instance, various hydrocarbons in time blocked the pores of the strata and rendered the project inoperative. He understood it was the practice of Dr. Gummert's organization to use activated carbon to remove substances such as butadiene and cyclopentadiene which, due to gum formation, might otherwise affect the porosity of the strata. It would be of interest to know whether the method adopted had been successful.

The author's remarks upon holder storage and the use of high-pressure mains for storage purposes were of particular interest. Could they be informed of the relationship between orthodox holder storage to the maximum daily demand and the additional storage provided by the grid mains pressures? His own view was that in our circumstances the total gasholder storage necessary throughout the grid areas, including that at production stations, was 45% of the maximum daily demand. Further experience and the development of peak load plants that could be brought on to the line quickly would probably lead to a reduction in this requirement. With an increasing demand the economics of gasholder storage became very important. In one case studied, the economics in storage costs arising from grid operations were not less than 0.2 pence per therm in respect of the total grid supplies.

The influence of the very close understanding and integration between the German heavy industries and the German gas industry was very important. There were developments quietly going on in this country, though probably not to the same extent, but there quite clearly seemed to be room for greater development in this direction, particularly the release of larger quantities of coke oven gas to steel works.

Commercial considerations must be taken into account in relation to the provision of oil gasification plant, but at the same time there were other aspects that one had to consider. For example, was it nationally right to spend money on constructing oil gas plants to make gas when the same oil could be used in large furnaces and can thus release gas for use elsewhere where it was preferred? Then the question of national capital investment became relevant. That would apply only in certain cases, and commercial considerations were, of course, very important.

An Astonishing Achievement

Mr. H. D. Greenwood (Ministry of Fuel and Power) referred to the paper he had given to the Institution in 1947 on the restoration of the gas industry in Germany between 1945-1947. At that time the total gas supplied from gasworks and coke ovens was only about 120 milliard cu.ft. per annum. In 1955 it had increased to over 430 milliard cu.ft. per annum, and 80% of this gas was derived from coke ovens at collieries and steelworks. When one considered what conditions were like in Germany in 1947 an increase in gas output of over 35% in 10 years was an astonishing achievement.

He assumed that Dr. Gummert had started his post-war statistics in 1949 on the basis that conditions had by then become more normal, and that there was adequate coal available—which was not the case in the earlier years. His figures showed that in the five years from 1949 consumption of gas increased by about 60% per annum. This increase had been mainly coke oven gas, and during this period the output of steel had about doubled.

Conditions in Germany, as Dr. Gummert had shown, differed materially from those in this country. The basic difference was that in Western Germany over 45% of the coal mined was carbonized; and 90% of this was in coke ovens outside the gas industry. In this country we carbonized only about 25% of our coal and about half of this was in coke ovens. Another difference was that while in Germany the coal carbonized in coke ovens at collieries and steelworks was twice as much as in England, the steel output was about the same in both countries. This meant that far more coke was used for industrial and domestic purposes than in this country.

British Consumption Higher

The total consumption of gas for all purposes was, however, appreciably higher than in Germany, being about 630 milliard cu.ft. per annum as compared with 430 milliard in Germany. The figure of 15.4 milliard cu.ft. which Dr. Gummert mentioned did not include coke oven gas used at steelworks, etc., which was, he thought, included in the German figure. The comparable figures were therefore 80% coke oven gas in Germany and 25% in this country—of which the gas industry distributed about 13%. The German system of showing graphically the production and utilization of all types of gas was a very convenient one and might with advantage be adapted here.

The extensive utilization of oven coke in Germany had been made possible and economical by the correspondingly large utilization of coke oven gas by industry. While some of this gas was supplied direct to industry from the coke ovens, the majority was distributed by the gas grid companies, of which Dr. Gummert's Company, Ruhrgas, was by far the largest.

An obvious question was: How have Ruhrgas been able to develop in competition with other fuels such an extensive use of gas by industry, a use which, we were told, was expected to increase at the rate of 7-8% per annum over the next 10 years? Although we might have some reservations about estimates so far in the future there was no doubt that gas consumption had been and still was increasing rapidly.

He thought we would find on enquiry that in the Ruhr gas was cheaper in relation to the cost of coal than it was in this country. There might be several reasons for this: The proximity of collieries and large industrial consumers; the economic distribution with the existing grid system; and the price system adopted by Ruhrgas. The close coordination between collieries and steelworks with the gas distribution companies was an important factor in the German system. Although oil was a serious competitor, the fact that Germany did not own any oil would always limit the extent to which industry became dependent on oil.

Industrial gas supplies were based almost entirely on the oven gas, and the fact that Ruhrgas have been able to supply a wide range of consumers with varying load factors on the basis of 100% coke oven gas might be a surprise to some people.

Since gas consumption was expected to double in the next ten years, the problem before Dr. Gummert and his colleagues was how to produce this additional gas. He assumed that it was not anticipated that the demand for coke would increase to the same extent, and

that the additional gas which could be obtained by heating the ovens with producer gas would only go a little way to meeting the demand.

Ruhrgas—an organization very closely associated with the collieries—based their plans for making more gas on the lower grades of coal which would not be required for coke production. In the past five years or so they had, in conjunction with other firms in Germany, developed and built large-scale plants for gasification of hard coal by the Lurgi process and for making producer gas from high ash coal for heating coke ovens. He thought the speed at which these developments had been carried through to large-scale production would give us a little food for thought!

The possibility of gasifying high ash coal at the colliery—transport of such coal would be uneconomic—and using the gas for heating ovens or retorts or even for power generation in gas turbines had always attracted him, and he had watched the Ruhr gas developments with much interest. Such a process would allow us to utilize some of the low-grade coals which we did not use today since they were so difficult to clean.

A further process was mentioned in the paper—the so-called 'pre-carbonization' of coal. In this process coal was carbonized in a 'moving burden' process, the hot coke being fed to boilers for power generation. Although much work had been done on this type of process, the Ruhrgas plant would, he believed, be the first commercial unit to be built. He believed it was hoped to produce town gas by this process at the same cost as coke oven gas.

In Germany there was a large consumption of electricity at collieries and it was customary to build power plants at collieries supplying to the grid. This pre-carbonization process thus fitted into the German system of integrated colliery, coke ovens and power plants with the gas and electricity grids. In this country we did not have anything like the same concentration of collieries and industrial units as in the Ruhr, but despite this he thought the combined gas and electricity generation might in some circumstances be an economic system.

Abstract of I.G.E. Communication 489

Domestic Coke Preparation at Kensal Green

By G. F. I. ROBERTS, B.Sc., Assoc.M.Inst.Gas E.,

and R. S. RODICK, B.Sc.(Eng.), Assoc.M.Inst.Gas E.,

Assistant Engineers, North Thames Gas Board.

THE carbonizing plant at Kensal Green consists of two modern retort houses each containing 48 continuous vertical retorts of rectangular cross-section and employing the lambent upward system of heating. The average daily quantity of coal carbonized is of the order of 770 tons and the normal sources of coal supply are the South Yorkshire, Derbyshire, and Nottinghamshire coalfields.

Open-fire coke and boiler fuel are supplied from Kensal Green works to a large number of domestic consumers in the North West London area, and from a study and analysis of their complaints it has been possible to determine the lines on which improvements to existing plants should be undertaken.

Before considering the problems and methods of coke preparation in any detail, it is necessary first of all to examine briefly the nature of coke and to consider the principal characteristics of the unprepared material, and it is intended to survey these properties in this section of the paper. The factors affecting coke quality considered in relation to the preparation process are: Sizing, ash and shale, reactivity, moisture, and bulk density.

Those basic characteristics of coke that have dominant effects on size separation are the initial size range of the run-of-retort coke, the mechanical strength of the material, and moisture content.

The overall effect of the handling and preparation processes on the run-of-retort coke, is to reduce the percentage of the larger sizes. It would be unreasonable to assume that the whole effect is due to mishandling of the coke, since many of the larger pieces are already fractured when they leave the retort, and, although retained by the larger screens, in a hand-testing process they need only a very mild impact to break down to smaller sizes. A certain amount of breakage from this cause is desirable since the coke market would not be able to accept the preponderance of large coke that would be produced if the actual yields were identical with the run-of-retort grading. The most significant figure is the breeze below ½ in., which, ideally, should be little more in the finished, than in the initial product, and efforts to reduce this type of degradation are likely to be very beneficial.

In order to assess the mechanical strength of the material, the standard method is to employ the 'shatter test.' While giving a guide to the strength of the material, the results obtained give little indication of the resistance of the coke to abrasion or shearing such as occurs in chutes, or screens, and when movement of the coke takes place within a storage bunker. A measure of the ability of a coke to withstand a number of relatively light impacts such as those occurring in the average grading plant can be obtained by careful sampling and grading analyses between convenient points in the preparation plant.

The effect of the moisture content on sizing is considered not to have very much influence on the performance of screens. The moisture content of the smaller size range does, however, have a very considerable effect, not on screen performance, but on the finished product by causing the presence of fine dust in otherwise well graded coke.

The question of ash removal is not considered in this paper, and it is difficult to see how the removal of finely divided ash can ever have practical application on the process of coke preparation. The removal of inert material in the form of shale is, however, practicable.

The term 'reactivity' is generally and sometimes loosely applied to the ability of the coke to burn satisfactorily in a consumer's appliance and is effected by the coal type, by residual therms in the coke, the moisture content, and then bulk density. The property of reactivity is one that has, hitherto, received rather less attention both in the production and preparation of coke, and it is probable that the somewhat nebulous nature of the property is largely responsible for this.

The choice of coal is at present determined mainly by the consideration of availability, suitability and price, and each of these is considered in relation to gas output. In many cases, as in the North Thames Gas Board, carbonizing plants are designed and built to carbonize, to the best advantage, a particular type of coal. In such cases, the nature of the coke produced is not likely to vary a great deal and in these instances a variation of the coal type as a means of affecting coke quality is not an easy question to resolve. It is now generally accepted that cokes from low-rank coals are more reactive, in the widest sense of the term, than those produced from high-rank coals

and that this applies to any type of carbonizing plant operating at high temperatures. If, as the Beaver Report suggests, coke produced on gasworks is to become one of the major sources of solid fuel in this country, then carbonizing plants of the future may have to be designed and operated to utilize a type of coal more suited to the production of a readily acceptable coke than to the maximum production of gaseous therms.

The presence of 'volatile therms' is common to all types of coke irrespective of the original coal type and the method of carbonization. The amount of volatile matter present varies very widely and it is common to find wide variations when testing coke produced from the same type of coal in one particular plant operating at practically constant carbonizing conditions. The relationship between reactivity and volatile therm content of coke is difficult to establish, but the general trend is for reactivity to increase with increasing volatile therm content.

The addition of water to coke in retort houses is practised for two main reasons:

(1) For quenching in the majority of static carbonizing plants.

(2) For dust control in continuously operated plants.

In certain types of continuous vertical retort installations, it is common practice to use a type of atomizing spray that injects water continuously into the coke chamber of the retort, a proportion of the water so added being evaporated and passing up the retort as saturated steam.

This system is capable of close control and the moisture contents are found in practice to be associated with a relatively dust-free run-of-retort coke which is dry enough to be efficiently screened, yet is still reasonably dust-free when loaded into sacks, and a dust-free coke has obvious advantages from the customer's point of view.

Bulk density is not affected by the processes of coke preparation being dependent on the type and size of the coal and the method of carbonization. In general, the bulk density of coke produced in continuous vertical retorts is lower than that from the static types of carbonizing plant, and ignitability is inversely proportional to bulk density.

Size Preparation

Size separation is, or should be, carried out as a regular feature of coke preparation, and, although widely practised, it is by no means an exact science. The two factors most affecting size separation are the physical characteristics of the coke and the loading applied to the screens. On the larger types of coke-preparation plant, the screens are normally situated at the outlet of a buffer hopper and are fed with coke by means of a slow-moving feeder conveyor. Variations of load in screen performance are thought to be due to the effects of segregation in the buffer hopper, coupled with higher breakage caused by the coke falling into an empty hopper at the start of the draw; which in general results in the screens receiving a larger proportion of the smaller sizes during the earlier part of the draw and a predominance of the larger sizes in the latter stages.

On some works, the retort house coke-grading plant is called upon to handle not only the run-of-retort coke, but also partially graded coke from other sources, e.g.,—small sizes separated by the debreezing screens on the carburetted water gas plant. It frequently happens that these factions contain a predominance of one particular size range and as such they present a difficult problem when an attempt is made to separate them on a conventional screening plant. Tests were performed on two screening plants in order to assess the ability of the screening plant to handle the type of rejected material to be expected if the aperture size of the debreezing screen on the sack-loading points was increased. The screening plants were fed by a conveyor consisting of a 24-in. belt, having a linear speed of 70 ft. per minute, situated below a ground-level dumping hopper.

It was observed that at high rates of flow, the standard of screening is adversely affected by overloading of the screen cloth, and that at low rates of flow, there is a tendency for pieces of coke to bounce off the screen cloths and contaminate other grades, although this is not such a serious fault as those obtaining under overload conditions. The rate of flow for a given throat opening to the feed conveyor is inversely proportional to the amount of nut-sized coke in the original sample, i.e.—to the bulk density of the material.

In general, the design of coke-handling plants tends to be affected by considerations of space and of the necessity to site the plant near to the retort house. Where ground space is limited, as on many gasworks, the necessary handling and storage capacity can only be obtained by making use of height and when this has to be done there are two attendant conditions:

(1) The necessity to use either vertical elevators, skip hoists, or long runs of belt conveyor.

(2) The necessity to build deep storage bunkers.

These two sets of conditions are, in greater or lesser degree, inflexible, and can exercise a profound effect on the process of coke preparation.

Vertical elevators may be subdivided into the gravity bucket or lip bucket elevators in use on large installations and the smaller, fixed buckets carried on a single chain, which are a feature of smaller plants. Both suffer from the attendant disadvantages of a high rate of wear and tear particularly when handling a material so corrosive and erosive as coke. Power consumption is high in proportion to the pay load. Capital costs are high. Breakdowns, should these occur, are often of a serious nature and can take a considerable time to repair. Against these disadvantages must be set the ability of this type of plant to lift vertically coke of any kind. They can also lift coke at a high rate for the expenditure of very little ground space and to any height likely to be required. In many cases, the gravity or lip bucket conveyor serves the dual role of coke and coal conveyance. From the preparation point of view, the disadvantages are that breakage occurs at the point of entry to the system where the fall is likely to be considerable, with some risk of crushing, and that a similar fall occurs when the coke is discharged from the conveyor.

Skip Hoists

Skip hoists can be used to provide an intermittent service and thus require some form of receiving hopper or feeder mechanism. The power requirement is not so great in proportion to the pay-load as that of the bucket elevators, and the plant is simpler to install and maintain. Disadvantages are the breakage of coke due to impact when filling the skip or its receiving hopper, and breakage as the skip discharges.

The great disadvantage of the use of belt conveyors, is the low angle at which the conveyor can work. The relation between vertical lift and length of conveyor is thus unfavourable. Against this can be set the advantages of relatively low maintenance costs and low power consumption in relation to the pay-load. Belt conveyors as such cause little breakage of coke, since it is never in contact with any moving parts of the conveyor, but the need to employ several in order to gain height can lead to a number of small impacts due to change of direction, the cumulative effect of which may be considerable.

It is extremely difficult to obtain an accurate assessment of the degree of breakage or degradation that occurs in the handling process when coke suffers an impact, due to the virtual impossibility of obtaining representative samples. From work done on testing of debreezing screens it is reasonable to assume that, for practical purposes, coke from continuous vertical retorts degrades to breeze to the extent of about 0.5% each time it suffers a moderate impact. Degradation occurring prior to the screening plant results in loss of revenue, but degradation occurring after the screening plant can, in addition to loss of revenue, give rise to complaints from consumers. Points at which degradation may be expected to occur are: At the point of entry to the conveyor system; at the junction of belt conveyors; at the buffer hopper; during the screening process; during the process of shale removal; during subsequent conveying operations to the storage bunkers; and in the storage bunkers.

Examining each point in more detail, it is apparent that the skip hoist suffers by comparison with either the bucket elevators or belt conveyors in that a receiving hopper is essential, and degradation by impact in this case is likely to be severe. It is in most cases very difficult to construct a type of chute that will lead coke on to the conveyor system without impact, and degradation at this point can only be kept to a minimum by careful design, and by ensuring that degradation does not occur unnecessarily due to grinding of the coke when the chute is overloaded. This second point can be covered fully in the design stage, but, frequently, careful supervision is required to ensure that retorts are not discharged at such a rate that overloading occurs.

Junctions of belt conveyors are, it is felt, liable to be overlooked at points at which degradation can occur. In many cases, the fall is not great, but, frequently, the purpose of the junction is to change the direction of the flow of coke; in these cases, particularly, breakage by impact can occur. While the amount of degradation at each individual point may not be great, the number of junctions that are included in most belt conveyor installations introduces a multiplication factor that can result in an overall amount of degradation of considerable magnitude. The blanket type of conveyor appears particularly useful, since it has the property of being able to carry material successfully at an angle greatly in excess of the conventional belt conveyor. This type of conveyor consists essentially of a belt conveyor, superimposed on which is a second belt, the two thus forming an enclosed trough up which the material is conveyed.

Entry to the buffer hopper is frequently associated with a considerable amount of degradation. It is common practice to empty completely this hopper after each screening operation. When the next cycle of operations commences, the first batch of coke to reach the handling plants falls into an empty hopper and the degradation caused by impact is severe. To overcome this, the only satisfactory way is to fit some form of chute that will break the fall.

Breakage occurring during the screening operations is difficult to assess and even more difficult to prevent. It is considered that the conveyor type of screen probably causes less breakage than the high-speed vibratory type. This point is only one of many to be considered when deciding upon the initial design of a coke-handling plant, and thereafter the degradation that occurs at this point is likely to be a constant factor. The only method by which an improvement may sometimes be effected is by paying careful attention to the design of chutes associated with the screening plant. It is of interest to note that the introduction of a chute designed as a true helix, in place of a chute of conventional straight-line design, reduced the degradation on screened open-fire coke (2¼ to 1¼ in.) from 3.5% virtually to zero.

Degradation of the coke during conveying operations from the screens to the inlet-point of the storage bunkers should, ideally, be negligible. The design of many coke-handling plants, however, includes a share-separation plant and may include by-pass chutes to stand-by plant, all of which tend to aggravate the position. In general, the amount of breakage may be expected to be small, but critical investigations may well result in significant improvements.

The final item listed, namely, degradation in the storage bunkers, by virtue of its serious effects has been widely recognized for some considerable time.

Geographical Limitations

As previously mentioned, the geographical location of the coke-preparation plant frequently imposes a limit on the ground area and forces the designer to obtain the necessary capacity by utilizing deep storage bunkers. A second equally important factor affecting minimum bunker size is the bulk density of the coke. The continuous vertical retort not only produces coke of a low bulk density, but also, by its very nature, requires bunkers of sufficient capacity to hold at least 12 hour make.

To focus the effects of degradation of coke to breeze against the whole background of coke preparation, it is of interest to study the financial aspect of a hypothetical case, which, it is thought, is not too far removed from practice. For this purpose, consider a handling plant with a throughput of 100 tons of coke made for sale per day, excluding breeze, and assume the overall degradation is 8%; we have therefore:

Potential yield of saleable coke		100 tons at £6 14s. per ton, yielding	£670
Potential yield of breeze	say 15 ,, ,, £3 4s. per ton, yielding		£48
Total potential revenue			£718
Coke lost by degradation, *i.e.*—8 tons at £6 14s. per ton			£53 12s.
Breeze gained by degradation of coke: 8 tons at £3 4s. per ton			£25 12s.
Overall loss due to degradation =			£28

On an annual basis, this loss wou'd amount to £10,320.

It will be apparent that, for the expenditure of a sum considerably less than that quoted, many improvements could be made which would yield an improved product.

The stocking and reclaiming of coke, although not a preparation process, has a very important bearing on the main subject. In general, carbonizing plants tend to be base-load units and as such invariably provide a coke stocking problem. The trend is likely to be to conserve all available coke for use as a domestic or industrial solid fuel. This indicates the urgent need to prepare for more extensive storage grounds and more intensive stocking programmes.

The storage ground at Kensal Green has an area of about 2½ acres and has held a maximum stock of graded coke of 16,000 tons representing only 8.7% of the annual coke production of the works. The stocking plant consists of a travelling stacker and two mobile cranes. The stacker is capable of building a heap some 35 to 40 ft. in height, and the larger of the two cranes will stack to a height of 35 ft. The stacker travels on fixed rails and has a lateral traversing range of 240 ft.; the boom is capable of luffing through angles varying from a depression of 9° below the horizontal up to an elevation of 19° above the horibontal, and will slew through an angle of 180°.

The total coke stock that can be held at Kensal Green is relatively low in relation to the make of coke, being slightly under half of the generally accepted optimum figure. This inevitably leads to a high rate of transfer to and from stock, by which method the peak stock is achieved at the time of the year when it is of the greatest advantage, i.e.—in early September to meet the coming winter trade. The transfer of coke to and from stock is likely to lead to an increase in cost and also an increase in the incidence of degradation, but has the advantage of allowing the bulk of the regular customers on the Kensal Green coke delivery district to receive their coke from one source; it is thought that this policy is likely to lead to fewer coke complaints. The overall approximate cost for the double operation of stocking and reclaiming coke, excluding breeze, for the year 1954-55 was 20.75d. per ton. This cost includes all items except capital charges.

Dry Cleaning Coke

A good quality coke is most easily produced by the carbonization of coals with a low ash content. Under the present conditions of supply, this is an ideal that is seldom possible, and alternative methods of improving quality are being sought.

The total ash content of coke may be divided into two parts:

(a) Inherent ash, uniformly distributed in the body of the coke.

(b) Foreign matter consisting mainly of shale.

There is no way of reducing the inherent ash except by carbonizing better coal, but, provided the ash content is not too great, it causes comparatively little difficulty to the consumer. On the other hand, shale, especially of the flying type, is quite troublesome.

Wet washing of domestic coke suffers the disadvantage of increasing the moisture content of the clean coke above an acceptable limit, and for this reason dry cleaning is advantageous.

One of the latest types of pneumatic shale operators is an adaptation of a type used extensively for the dry cleaning of coal, and deals with about six tons of coke per hour. The operation depends on the air flotation of a mass of coke so that the denser fragments, including the shale tend to sink to the bottom of the bed, and can be separated by a vibratory motion of the deck plate.

The cost of operating the separator is given as 26.1d. per ton of coke cleaned. It may be represented that the removal of a portion of material that would otherwise be sold at the current price of coke, should be counted as an additional charge on the cleaning process. For 1% of shale removed, this cost would be another 17.3d. per ton. Furthermore, it may be noted that any loss of coke in an attempt to obtain complete removal of the shale with this plant is serious, since it also represents a charge at the same rate.

The cleaning of open-fire coke on a similar machine to that for the coke nuts was attempted as an experiment. On carrying out tests on this plant, however, it was found that the separation was extremely poor and that with any shale removed there was approximately an equal quantity of coke. The cost of operating this machine on open-fire coke was thus quite out of proportion to an improvement in coke quality.

The main factors affecting the quantity of breeze produced have been dealt with previously. They are, the type of coke produced, the design and layout of coke-handling plant, and the storage of coke.

The removal of breeze is generally practised in two stages;

first, in the grading of run-of-retort coke, and secondly in debreezing graded coke immediately before loading into vehicles. In all works where close grading of the product is an essential requirement, the problem of degradation of coke after the primary screening is of great concern. Rather more importance is attached to careful handling at this stage than previously and, wherever possible, measures are taken to minimize direct falls and impacts that would cause reduction in size and contamination with breeze.

A certain amount of degradation will inevitably take place in the process of shale separation, but this is counteracted to some extent by the removal of fines by the dust extractor over the separating table.

Spiral chutes in hoppers are of definite advantage, preventing breakage through falling a distance, especially when the hopper is nearly empty, and also reducing crushing. They are also valuable in preventing segregation of coke and breeze on entry into the hopper. The latter is a feature experienced with conveyor belts, fine breeze often falling vertically from the head pulley and landing a short distance from the main stream of coke. Depending upon the position of the hopper outlets and the working of the hopper, it is frequently possible for an accumulation of this dust to build up into a column, or pillar, sometimes caking if moist, and periodically collapsing under its own weight. This occurs usually when the level of coke in the hopper is falling, and results in a temporary overloading of the de-breezing screen placed at the outlet.

The removal of the breeze from graded coke may be performed either by a 'guard' screen or by a smaller-meshed debreezing screen. At Kensal Green works, debreezing is carried out at hopper outlets by means of inclined reciprocating debreezing screens. Similar units for debreezing graded coke reclaimed from the stock heaps are also installed in the Harmer loaders. The operation of such a debreezer depends upon a number of factors, including the size of the apertures, the slope of the screen, its speed, rate of feed, grading of material fed to it, *etc.* In order to investigate some of these characteristics, tests were carried out with the co-operation of the manufacturers the A.C.E. Machinery Company, Ltd., on a special rig.

In the North Thames Gas Board's area the systematic analysis of consumer complaints has been developed in order to give to individual works some indication of the trend of opinion regarding the quality of the coke they produce. Burden and Eaton have described the assessment of this data and shown how such information in conjunction with laboratory tests can be usefully applied. During the period in which much of the work of improvement at Kensal Green was carried out, in spite of considerable increases in the price of coke, which would greatly stimulate the critical attitude of consumers, it is interesting to see the decline in the level of complaints. The greatest attention has been focussed upon the questions of reducing the formation of breeze and removing shale. The introduction of various preventive measures to deal with the breakage of graded coke, and modification to the shale-separating plant, together with selection from the limited range of coal supplies of the most suitable types for carbonization, have gone far to reduce these sources of dissatisfaction. Complaints with regard to grading have been cut down and those concerning moisture in coke have been virtually eliminated.

DISCUSSION

Mr. J. A. Hepworth (North Thames Gas Board), opening the discussion, said that as all their coke was produced in continuous vertical retorts, Kensal Green had no serious problem with high moisture content. It was worthy of note, however, that it had been found advantageous to provide suitably designed and closely controlled water injection into the lower castings of the retorts which ensured a moisture content satisfactory to the customer and largely eliminated dust during discharge and subsequent handling. Regarding screening, size separation was not an exact science, but much valuable information was now available concerning the operational efficiency of various types of screens and screen cloths. The paper, however, produced further evidence that the essential requirement for efficient screening was a steady and regulated flow of coke, feeding screens of suitable size and capacity. As the supply of coke from carbonizing plants was inevitably intermittent to some degree, it was desirable to use a buffer hopper with a feeder conveyor to supply the primary screens. If the arrangement of plant did not allow a constant and regulated flow, then it was very important to have a screen of sufficient capacity to meet the maximum flow likely to be encountered. There were many examples of poor efficiency due to failure to appreciate the maximum loading imposed.

Degradation to Breeze

The investigations of the authors also confirmed strikingly that, particularly in the case of continuous verticals, degradation of coke to breeze was probably the most troublesome and costly feature of coke handling and that thoughtful design and selection of plant were required if it was to be minimized. The figure quoted of ½% degradation from each moderate impact of the coke was significant and emphasized the need for careful design throughout. The simplest layout using the minimum number of belt conveyors with the minimum practical depth for buffer and main storage hoppers was clearly to be recommended. It had been proved that suitably lined spiral chutes delivering deep into the hoppers operated quite successfully and reduced degradation appreciably.

While it was desirable to persuade customers to purchase coke for stock during the summer months, it was inevitable that substantial stocks of coke must be accumulated on works during that period. Degradation of coke to breeze must occur in this process and could assume serious proportions. The stocking plant at Kensal Green was, he believed, the ideal plant for the purpose but required a particular disposition of storage area. Alternatively, the formation of shallow heaps by tipping lorry and with scoop machines for trimming and of deep heaps by tipping lorries climbing the heaps on prepared tracks had proved to be the most desirable methods for achieving stocking with minimum degradation. For either the stocking or reclaining of coke, scoop machines were less damaging than grabbing cranes.

Despite all preventative measures, coke at hopper and ground loading points would contain breeze which should be removed before delivery to the customer. The installation of efficient mechanical debreezing screens at all loading points was essential. Many types of portable sack loading units with mechanical debreezers and portable debreezing units for bulk loading were now available.

Problem of Shale

Shale in coke, particularly boiler nuts, had been the source of much complaint. Its complete removal was difficult and costly. The dry cleaning plant at Kensal Green was the latest of its type; but despite considerable research and improvements made by the authors the normal effective removal of shale from boiler nuts was rather less than 60%, and experiments to remove shale from broken coke had not been successful. They all wished there was some prospect of receiving coals with insignificant shale and bats content; and, although in the meantime they would consider it their responsibility to remove shale from boiler nuts as far as practicable, there was need for further work to establish improved techniques and designs of plant.

Importance of Sizing

Dr. F. A. Burden said that the importance of coke grading demanded more attention to the plant than the mere replacement of screen plates as infrequently as possible. At the present time, when domestic coke was receiving some of the attention it merited, the importance of sizing must not be under-estimated. For a given carbonizing plant the ash, reactivity, and bulk density were governed by the coal supplied. Small variations might be produced by plant operating conditions, but major changes were usually precluded by gas-making considerations. The moisture content of the coke was controllable, subject to plant limitations, but at acceptable levels had little effect on performance. The shale content was dependent upon the coal carbonized, except only that in the case of boiler nuts a useful improvement could be effected by dry-cleaning processes. There remained sizing alone, as the one factor under the full control of the producer.

Study of Complaints

The authors had referred to the analysis of coke complaint data, and gave graphs showing the reduction of complaints from the various causes. In the

use of such data two problems presented themselves. The first was the relation of a complaint to its correct production period. A time-lag always occurred between delivery and complaint, which might vary between a week or two during the winter period and several months for a delivery made at the end of the heating season. With coke recovered from storage it might be difficult to determine whether or not a complaint referred to present production, so that arrangements must be made for the ready identification of the source of any one consignment. In addition full records of works operation must be available.

The second problem lay in the expression of the results obtained. A complaint when received referred to a single delivery which could be of 5 cwt. or 5 tons. Thus a bad bulk delivery causing one complaint could in other circumstances have caused 10 or even 20 complaints. It was normal therefore to express the results on the basis either of tonnage delivered or of number of deliveries, to eliminate the effect of peak delivery periods. The method of expression should be selected according to the data available and in relation to the information which was required. For this reason it was dangerous to attempt to draw conclusions from a graph alone, without the other relevant details which were required for interpretation.

Yearly Running Average

Considering the first complaint graph (Fig. 7 in the paper), the classified complaints were expressed as a yearly running average and showed a steady fall in the number. The rise at the end of 1955 was due almost entirely to shale. The basis, however, masked the effect of individual plant improvements, since a sudden reduction of complaints maintained over a number of months was only shown as a gradual change over the same period. It would be interesting therefore to know the cause of the very sharp drop in complaints during March and April, 1954. The possibility of a seasonal effect could not be ruled out since a similar but smaller fall was recorded in the following year; but there was always some difficulty in interpreting past records, and this might be the reason both for this effect and also for the employment of the yearly running average.

Nevertheless the present implications of the graph were clear. The most important single cause for complaint was breeze. This had shown no improvement for 18 months and warranted further investigation. Grading had shown a steady improvement, and the expression on a monthly instead of a yearly basis might show present trends more clearly. The increase in shale complaints suggested a change of coal for carbonization with no ready solution on the works level. Reactivity and moisture were satisfactory, while the constancy of 'other reasons' further illustrated the usual proportion of faulty appliances and faulty appliance operation which always occurred, even among the best regulated consumers.

Mr. G. J. B. Cox (Edinburgh) referred first to the comparison (Table 2) between calculated and actual yields of graded coke. They had carried out tests at Granton some months ago when carbonizing 75% of 901 and 902 coals in continuous verticals, and there the change in the gradings from input coke to the output of the plant worked out as follows: For over 2½ in. the figures were 6.3% input and 2.7% output—a drop of 57%; for 1¼-2½ in., 41% input and 29.9% output—a drop of 27%; for ½-1¼ in., 28% input and 40.1% output; and the under ½ in. increased from 24.2 to 27.3%. Unfortunately, the sizes did not quite coincide with those in the table.

In Edinburgh they had experimented to ascertain the degradation in bunkers without spiral chutes and found that the degradation in over 2½ in. coke was 47% in one case and 40% in the other. The next size, 1¼-2½ in., dropped by 11% in one case and 19% in the other test. There was very little change with the small size.

No Moisture Complaints

Regarding complaints, they in Scotland were fortunate in that they did not get moisture complaints at all; or if they did get them, it was because there was not enough moisture. The problem with Scottish coke was that it made dust very much more easily than the English; and therefore not only the consumer but those responsible for its delivery would not look at it unless it had a reasonable amount of moisture. Nor did they suffer from reactivity unless they got a large batch of English coal, and then it was usually the industrial consumers rather than the domestic consumers who worried about it.

Their principal source of trouble, as at Kensal Green, was grading, and in that respect, they were hoping to carry out one or two small experiments to ascertain the further degradation of coke in transit between the works and the consumer.

Mr. F. G. Pyper (Chief Engineer, East Midlands Gas Board) averred that, when he first joined the gas industry, it had been pointed out to him that coke had features in common with an egg, a sponge, and emery—in that it was fragile, absorbed moisture, and was very abrasive. With these attributes, the handling of coke must always be a difficult and expensive problem, and the paper gave a very good account of how the problem had been examined and tackled on a large works. The methods employed and the details obtained during the tests and researches of the two authors were an excellent contribution to knowledge, and their success was amply confirmed by the chart showing the reduction in complaints.

It had been noted that the screens were of the high-speed vibratory type, but were the screen cloths of woven wire? Had the authors any experience with screens of the perforated plate or the spot-welded wire type?

The comments on the breakage of coke at chutes and by falling in hoppers were very relevant. The design of chutes was always a problem, and there was at one time a suggestion that at change-over points on belt conveyors the coke should fall from belt to belt without any intervening chute. He did not know how far this idea was pursued; but with large belts and, consequently, large head pulleys, he did not think there would be any advantage. Had the authors any comments on that point? The installation of spiral chutes in hoppers was now well proved, but there was an opinion that breakage was negligible except in the large-coke hoppers.

Debreezing Essential

Debreezing was always a problem, and undoubtedly the ideal solution was the "guard screen" mentioned in the paper. This, however, complicated the handling plant design and involved much more rescreening than probably the slight improvement in the size of the coke sold really justified. In this connection, in the authors' section on reclaiming, the bagged coke was debreezed on the Harmer loaders, but the coke delivered in bulk appeared to be taken straight from the stock heap to the wagons or lorries. Did this mean that bulk loads were not debreezed and that the authors considered it unnecessary? In Sheffield they had debreezing units for coke both in bulk and in bags, for loading into all wagons and lorries, and regarded them as very desirable, even essential.

On the question of stocking coke, there must always be a difference of opinion on whether the coke should be stocked screened or as 'run-of-retort' coke. The latter must involve a larger screening plant if the coke was to be loaded at a high rate, but it must be conceded that the product loaded was almost certainly better sized. They were trying both methods in the Sheffield area. The right decision probably depended really on local circumstances.

Mr. H. B. Bassett (West Midlands Gas Board) remarked that the authors referred to the necessary evil of stocking coke and recommended some form of preferential summer tariff in order to persuade customers to stock their winter fuel requirements during the summer. The speaker suggested that the average modern householder was unable to do so, and that the customer was fed-up with continual pressure to act against his will. The gas industry must face up to the future and to the gradual building-up of opposition to solid fuel and be prepared to supply good quality coke for immediate delivery. To this extent they must organize their undertakings to give the best service at as low cost as possible.

Birmingham Practice

In the Birmingham Division of the West Midlands Gas Board, that was their aim. They were called upon to meet orders up to a peak of 18,000 tons per week during the winter quarter, 90% of which was sold to or through merchants or by truck. This figure was about 50% in excess of works availability and included about 1,300 tons delivered in bags by Board vehicles.

To meet that demand, coke handling was re-organized. Little or no coke was stocked on the works, where space was limited, and all surplus coke, especially during the summer months, was taken by lorry to a site 1 to 2 miles from the

three Birmingham works, with stocking space up to 65,000 tons, or 9.4% of the annual production from the three works. The graded coke was unloaded on to separate stacks. It was reclaimed by grab and loaded as follows:—

1. Through 2 debreezing and bagging units capable of handling 15 tons per hour each.
2. Through 2 debreezing units with chutes suitable for truck loading at 30 tons per hour each.
3. Through 1 debreezing unit with chute suitable for lorry loading at 40 tons per hour.

Thus it was possible to load, with 3 cranes and with a reasonable degree of flexibility, up to 4,000 tons per week, during normal working hours. Thus, too, they were able to maintain even at peak weather conditions and at a reasonable cost good delivery dates, quick turn round of vehicles, and were able to relieve the works screens and plant of the added burden of re-screening. During last winter coke bagging deliveries were maintained at under 5 days from receipt of order at the works. That figure included washed coke.

Dr. A. E. Haffner (Chief Engineer, Southern Gas Board) remarked that with the increasing tendency to expect coke to take up a major share of the increased cost of coal, coke prices had reached a level where the customer was certainly entitled to expect a high-quality product. He wondered if, in spite of difficulties of sampling, it had been possible to get some quantitative indication of the degradation that occurred in the various linkages in a mechanical conveyor system. They had been told that this amounted to ½%. Were there more specific cases which would enable them to select the better of two alternatives? And would it be possible to add the coke in the shale rejected, the dust collected and the breeze produced per ton of coke treated?

There were a number of factors to be considered when analyzing results obtained from tests on screening plants. One of importance was the amount of near-size material in the feed. In this case, with a ⅜ in. screen, the near-size material could be taken as being between ¼ in. and 1 in. The higher the percentage of this size the more difficult was the separation process. It would be of interest to know if the percentage of ½ in.-1 in. or ½ in.-⅜ in. material was excessive in test 3.

The Gas Council recommended that boiler nuts should contain at least 90% ½ in.-1¼ in. with not more than 5% below ⅜ in. If the finished product contained 70% or more, between ⅜ in. and 1¼ in., then it would contain sufficient between ½ in. and ⅜ in. to bring the product up to the Gas Council recommendation. He, the speaker, disagreed, most strongly with the authors that test 4 (Table 4) gave results which were scarcely acceptable for a saleable grade of coke. It would easily conform to the Gas Council recommendation and provide an excellent fuel.

These various tests were most useful in showing the way to improving coke. If the product was to be consistent and of satisfactory quality, then it was necessary to consider the material to be separated and to adjust the aperture size and rate of feed accordingly. It was impossible to make day-to-day changes of the aperture size; this must be chosen to give the best over-all performance. It was important, however, that adequate provision be provided for the control of the rate of feed.

Regarding breeze, the authors rightly said that spiral chutes were of definite advantage in preventing breakage. It would be of interest to quote results recently obtained at Kensal Green on open-fire coke during a test lasting seven days. Samples were taken at the inlet and outlet of a hopper containing a spiral chute with a vibratory ¼ in. debreezing screen at the outlet. Results were as follows:

	Inlet	Outlet
1 in.-¼ in. ...	3.8%	4.9%
Below ¼ in. ...	3.2%	2.2%

The fact that there was no appreciable change in the larger size showed that the amount of breakage was little. The decrease in the small material indicated that the debreezers were capable of dealing with the inherent breeze and the probable small amount formed in the hopper. Perhaps the authors would compare these results with the results at Kensal Green before the spiral chutes were put in.

Breeze was one of their chief complains, and time spent on the problem could never be time lost.

Authors' Reply

Mr. R. S. Rodick said that with continually rising prices the public were becoming hyper-sensitive, and it was up to the production engineer to see that all in his power was done to minimize causes of complaint.

The authors appreciated the comments of all the speakers and, in particular, the interesting figures given by Mr. Cox relating to Granton. The number of complaints depended to some extent on the size of the individual plant. At Kensal Green they had large numbers of deliveries amounting to only 5 cwt. at a time, so that one had a large number of complaints for a relatively small amount of coke delivered. With regard to the use of complaints data, it was seldom possible to link changes in figures with a particular alteration or occurrence unless it were one of a major character. This was partly due to the inevitable time-lag.

It was also found that a large proportion of consumers made complaint on more than one score. Many were apparently prepared to accept some imperfections; but if their dissatisfaction rose to the point of making a complaint, they painted a very black picture. On the other hand, if improvements were made in one direction, they very often led to a general fall in complaints under all headings.

For Services Rendered

All in the gas industry will wish to extend congratulations to the following whom H.M. The Queen has honoured for good service.

Knighthood

Thomas Williamson, Esq., C.B.E., J.P., General Secretary, National Union of General and Municipal Workers.

O.B.E.

Geoffrey Barlow, Esq., Managing Director, Meters Ltd., Manchester.

James Leggat Hyslop, Esq., J.P., Engineer and Manager, Belfast Gasworks.

Cyril Aubyn Masterman, Esq., Technical Director, Underground Gasification Trials, Ministry of Fuel and Power.

M.B.E.

John Basil Brennan, Esq., General Secretary, Institution of Chemical Engineers.

Oswald Pilkington Cronshaw, Esq., North Wales Grid Manager and Chairman, Clwyd and Deeside Group, W.G.B.

Alexander Jamieson, Esq., Group Manager, Western Group, Scot. G.B.

B.E.M.

George Henry Cooper, Exhauster Man, Wolverhampton District, W.M.G.B.

Joseph Hancock, General Maintenance Man, Exeter Gas Works, S.W.G.B.

Chad Henry Law, Fittings Superintendent, Cardiff Undertaking, W.G.B.

Earnest Lee, Purifier Foreman, Salford Works, Manchester Group, N.W.G.B.

Robert Peart, General Foreman, Stanley Works and District, N.G.B.

Richard Twells, Charge-Hand, Litchurch Works, Derby Undertaking, E.M.G.B.

Sidney Benjamin Woodhouse, lately Superintendent, Distribution Repair Shops, Tottenham Division, E.G.B.

Personal

MR. S. T. FRANKS has relinquished his position as Works Manager of Edward Cockey and Sons, Ltd., Frome, Somerset, after six years' service with the company in this capacity.

MR. JAMES G. MCEWAN, Sales Officer, Alloa-Stirling sub-group, Scottish Gas Board, has been appointed Divisional Sales and Service Superintendent, South-East Division, Edinburgh.

MR. J. B. LONGMAN has been appointed Technical Sales Representative of the Baird and Tatlock Group of Companies for South London and the South of England in succession to Mr. P. H. D. Andrews, who has retired to South Africa.

MR. R. G. HUXTABLE, M.B.E., has been appointed Secretary to the South Eastern Gas Board. Born at Woolacombe, Devon, Mr. Huxtable was educated at Ilfracombe Grammar School, and Wadham College, Oxford. He qualified as a solicitor in 1935 and was engaged in private practice in the commercial and industrial fields until 1940, when he joined the R.A.F.V.R. During his war service he was awarded the M.B.E. In 1946 he returned to the law and four years later—in1949—was appointed solicitor to the South Eastern Gas Board.

THOMAS BAYLEY (GREAT BRIDGE) LTD.
BAGNALL STREET, GREAT BRIDGE, STAFFS.
Telephone: 1587 Tipton
Manufacturers of Best Staffordshire Blue, Brown and Red Engineering Bricks
Blue pressed and Wirecut Paviors for Hopper Linings and Retort House Floors

EWART CHAINBELT CO., LTD.
DERBY, ENGLAND
Driving and Conveyor Chains of the best quality; made of Ley's Celebrated Blackheart Malleable Iron.
ALSO COMPLETE CONVEYORS AND ELEVATORS

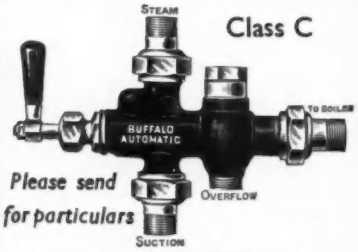
GAS METER CRANKS
Telephone: DUNSTABLE 90
The Clifford Engineering Co., Ltd.
Dunstable, Beds.
Specialists for over 30 years
Single and double throw cranks for all meters

J. BROWN & CO. LTD.
SAVILE TOWN, DEWSBURY, YORKS.
Supply:–
"BROWNOX-de-LUXE" PURIFYING MATERIAL
Purchase:–
SPENT OXIDE

ENGINEERS' SMALL TOOLS
DRILLS, FILES, VICES, TAPS & DIES, HACKSAW BLADES
VEE BELTS · BELTINGS
GEORGE E. SAWYER, LTD., 35/36 ASTON STREET, BIRMINGHAM, 4
Phone: ASTon Cross 1163 & 2642 Grams.: "Accomplish"

CASES FOR BINDING
Quarterly Volumes of the 'Gas Journal'
7/6 each, post free
Walter King, Ltd., 11, Bolt Court, Fleet Street, London, E.C.4.

OXIDE
DUTCH AND DANISH BOG ORE SPECIALLY ACTIVATED OXIDE OF IRON
Oxide supplied on loan or sale outright.
Highest prices paid for Spent Oxide.
Send your enquiries to
GAS PURIFICATION LIMITED
PALMERSTON HOUSE, BISHOPSGATE, LONDON, E.C.2.
Telegrams: "Purification, Stock, London." Telephone: London Wall 7938/9 & 7930

BUFFALO INJECTORS
Class C


Please send for particulars
GREEN & BOULDING, Ltd.
162a Dalston Lane, London, E.8

APPOINTMENTS VACANT

WOODALL-DUCKHAM CONSTRUCTION CO. LTD. has a vacancy in connection with development and testing work on coke oven and by-product plants. The position would involve three to four years of interesting and varied site experience with opportunities for initiative following which a Head Office post would be offered. Candidates, aged preferably 25 to 28, should be of degree standard and some experience in this field would be an advantage. Starting salary £700 to £800 according to age and experience; staff bonus; lodging allowance whilst outside; generous pension and insurance schemes. Apply in writing giving particulars of age, qualifications and experience to The Personnel Officer, Woodall-Duckham Construction Co. Ltd., 63/77, Brompton Road, London, S.W.3.

CLERK (Male, age 25-45) required by large firm of Engineering Contractors. Quick at figures, good handwriting. Engineering experience advantage but not essential. Commencing salary £450 to £550 per annum. Pension and Insurance Schemes; Staff Bonus Scheme; Canteen. Holidays by arrangement this year. Write with full particulars to The Personnel Officer, Woodall-Duckham Construction Company Ltd., 63-77, Brompton Road, London, S.W.3.

NORTH WESTERN GAS BOARD

LIVERPOOL GROUP
ENGINEERING DRAUGHTSMAN

APPLICATIONS are invited for the above pensionable appointment at a salary within Grade A.P.T. 7 (£670/£750 per annum).

Applicants should be of good general education and have reached at least Higher National Certificate standard. Experience in any of the following would be an advantage—design and construction of gasworks or allied plant, pipe work, pumps, vessels and steam utilisation and steel structures or mechanical handling plant. A knowledge of electrical engineering would be considered an additional advantage.

Application should be made in writing to the Chief Personnel Officer, N.W.G.B., Liverpool Group, Radiant House, Bold Street, Liverpool, 1, within 14 days.

WALES GAS BOARD

TECHNICAL ASSISTANT (DISTRIBUTION)

APPLICATIONS are invited for the position of Technical Assistant (Distribution) in the Pontypool Undertaking.

Candidates should have a good knowledge of gas fitting, high and low pressure distribution and experience of mainlaying would be an advantage.

The salary will be within Grade 7, Provincial A (£670-£750) per annum of the National Salary Scales for Gas Staffs, according to qualifications, and the post is pensionable.

The successful applicant will be required to pass a medical examination.

HOME SERVICE ADVISER

APPLICATIONS are invited for the position of Home Service Adviser (Senior post) in the Pontypool Undertaking.

Candidates should possess a recognised qualification in Domestic Science and have experience in the organisation of Cookery Demonstrations, Lectures and District Home Service calls.

The commencing salary will depend on qualifications and experience and will be as follows:—

Home Service Adviser (Senior post—Grade 6 Female—£512/£575 per annum and the post is pensionable.

The successful applicant may be required to pass a medical examination.

Applications for the above positions, stating age, qualifications, experience and the names of two persons to whom reference can be made should reach the undersigned within fourteen days of the appearance of this advertisement.

A. FACER,
General Manager and Engineer.

Gas Offices,
Hanbury Road,
Pontypool, Mon.

WALES GAS BOARD

PRODUCTION ASSISTANT

APPLICATIONS are invited for the post of PRODUCTION ASSISTANT, who will be based at Technical Headquarters, Cardiff, but will be required to travel.

The successful applicant, who must possess the necessary qualifications and experience in Gas Engineering, will be engaged on promoting efficiency in works operation and of development work to increase capacity of existing plant and to take advantage of new sources of gas supply.

The commencing salary will be within Grade A.P.T. 9A (£755/£855 per annum) and the post is pensionable.

The successful applicant will be required to pass a medical examination.

Applications, stating age, training, qualifications and experience, together with the names of two referees, should reach the undersigned not later than June 18, 1956.

C. B. MAWER,
Secretary.

2, Windsor Place,
Cardiff.

WALES GAS BOARD

CHIEF ACCOUNTANT'S DEPARTMENT
APPOINTMENT OF ASSISTANT CHIEF ACCOUNTANT

APPLICATIONS are invited for the above appointment for which the salary payable will be in the range £1,525 to £1,725, the commencing salary being fixed in relation to experience and qualifications. The post is pensionable.

The selected candidate will be required to pass a medical examination.

Candidates should be qualified accountants, and preferably have had experience in public utility accountancy, including costing, estimating, machine accounting, and the carrying out of organization and methods examinations.

Applications, stating age, particulars of appointments held, experience and qualifications, together with the names of two referees, should reach the undersigned by June 19, 1956.

C. B. MAWER,
Secretary.

2, Windsor Place,
Cardiff.

NATIONAL COAL BOARD (East Midlands Division). Applications are invited for the post of Chemical Plant Manager at a large complex coke oven and chemical plant. Applicants should have a thorough knowledge of the principles of chemical engineering and industrial chemistry, in particular, experience in Benzole rectification, distillation, sulphuric acid and sulphate of ammonia manufacture and gas purifications required. Salary will be in accordance with qualifications and experience. Applications marked 'S.V. 566' with details of age, education, qualifications and experience should be sent, within fourteen days, to the Staff Director, National Coal Board, East Midland Division, Sherwood Lodge, Arnold, Notts.

(*Classified advertisements continued on page 781*)

PUBLISHERS' NOTICE

The " Gas Journal " is published every Wednesday, price 1/6d.; by post 1/8d.

Subscription Rates: Home and Empire:—60/- per annum; Foreign:—70/- per annum. (Both payable in advance.) A copy of the " Gas Journal " Calendar & Directory is presented each year to continuous subscribers.

Classified Advertisements: All small classified advertisements are charged at 2/- per line (approx. 7 words)—minimum charge 10/-. A Box Number address occupies 2 lines, and a further 6d. is charged towards cost of postage on replies. Copy must be received by first post on Monday to ensure insertion in that week's Journal.

Displayed Advertisements: Rates obtainable on application to the Business Manager. Change of copy for displayed spaces must be received 14 days prior to publication if proofs are required. Type area of inside pages 10 in. deep × 7 in. wide; block screen 120.

BUSINESS MANAGER: S. T. CULLEN

NORTHERN MANAGER: Philip W. B. King, Flat 1, 7 Langcliffe Avenue, Harrogate. *Telephone:* Harrogate 67625.

SOUTHERN & MIDLANDS REPRESENTATIVE: A. Engelhardt, T.D., 11, Bolt Court, Fleet Street, E.C.4. *Telephone:* Fleet Street 2236-7.

WALTER KING, LTD., 11, Bolt Court, Fleet Street, London, E.C.4.

Telephone: FLEet Street 2236-7. *Telegrams:* Gasking, Fleet, London.

APPOINTMENTS VACANT (*ctd.*)

FIRST CLASS GASFITTER required for Wolverton/Stony Stratford District (Northampton Group): Provincial A rates of pay. A house situate in Newport Pagnell is available on reasonable terms under a Service Occupation Agreement.

Applications stating age, qualifications and experience, together with the name of a referee, should be addressed to reach Mr. E. B. Craddock, Group Manager, East Midlands Gas Board, 45, Abington Street, Northampton, not later than June 9, 1956.

H. B. TAYLOR,
Divisional General Manager.

EAST MIDLANDS GAS BOARD

LEICESTER AND NORTHANTS DIVISION
LOCAL SUPERINTENDENT—ASHBY-DE-LA-ZOUCH

APPLICATIONS are invited for the appointment of Local Superintendent, Ashby-de-la-Zouch. The post is graded A.P.T. 5/6, Provincial A (£575/£690).

The successful applicant will be responsible for Sales and Service in the Ashby and Measham Districts (approximately 1,650 consumers) and will be required to undertake certain standby duties, on a rota basis, in connection with the grid reception/holder station, for which an appropriate payment will be made.

A modern house is available on reasonable terms under a Service Occupation Agreement.

The appointment is pensionable and the successful applicant will be required to pass a medical examination.

Applications stating age, present position and qualifications, should be addressed to reach the undersigned not later than Thursday, June 21, 1956.

H. B. TAYLOR,
Divisional General Manager.

Millstone Lane,
Leicester.

EAST MIDLANDS GAS BOARD

LEICESTER GROUP
ACCOUNTANT (COSTS AND EXPENDITURE)

APPLICATIONS are invited for the position of ACCOUNTANT (Costs and Expenditure) to the Leicester Group of Undertakings. The post is graded A.P.T. 12 (salary range £900/£1,025) and the initial salary will be commensurate with the qualifications and experience of the successful applicant.

The Accountant will be responsible to the Divisional Accountant for cost and expenditure accountancy in the Group, which comprises some 152,000 consumers, and his duties will include the general supervision of a punched card installation.

Applicants should hold an accounting qualification and have the ability to supervise and control staff, preference being given to a candidate with experience in the development of management accounting techniques.

The appointment is pensionable and the successful applicant will be required to pass a medical examination.

Applications stating age, and giving details of qualifications, experience, present position and salary, together with the names of two referees should be submitted to reach the undersigned not later than June 16, 1956.

H. B. TAYLOR,
Divisional General Manager.

Gas Offices,
Millstone Lane,
Leicester.

May 26, 1956.

EAST MIDLANDS GAS BOARD

LINCOLNSHIRE DIVISION

APPLICATIONS are invited for the position of GASFITTING FOREMAN in the Grimsby Group. Applicants must possess a City and Guilds 1st Class Gasfitter's Certificate.

The salary payable will be within Grade A.P.T. 4a of the National Salary Scales for Gas Staffs (£535/£615), according to experience.

The position is pensionable and the successful applicant will be required to pass a medical examination.

Applications stating age, experience and present position, together with the names of two referees should be addressed to the Group Manager, East Midlands Gas Board, Sheepfold Street, Grimsby, to arrive not later than June 16, 1956.

EAST MIDLANDS GAS BOARD

LINCOLNSHIRE DIVISION

APPLICATIONS are invited for the position of LABORATORY ASSISTANT (male) at the Bracebridge Gasworks, Lincoln.

The salary for the post is within the grade A.P.T. 4, £445/£595 per annum.

Applicants should preferably have attained National Certificate standard in Chemistry and have completed their National Service training.

The Laboratory covers a wide and interesting range of analytical work including solid fuels, oils, waters and effluents, in addition to Instrument Testing and investigations into varied technical problems at works.

The situation has promotional prospects and carries good holiday and sick pay schemes.

The position is pensionable and the successful candidate will be required to pass a medical examination.

Applications stating age, qualifications and experience and quoting the names of two referees should be submitted to the Divisional General Manager, East Midlands Gas Board, Belle Vue House, Carline Road, Lincoln, to arrive not later than June 23, 1956.

EAST MIDLANDS GAS BOARD

NOTTS. & DERBY DIVISION
HOME SERVICE ADVISERS—Derby District, Heanor District—Burton-upon-Trent District

APPLICATIONS are invited for the positions of HOME SERVICE ADVISERS in the above Districts.

The salary payable will be within the range £405/£525, the commencing salary depending on age, qualifications and experience.

Candidates must be capable of working independently and be in possession of a recognised Diploma in cookery and/or domestic science. They should be proficient in the practical demonstration of gas cooking, laundry and other appliances involving the use of gas in the home.

The positions are pensionable and the successful applicants will be required to pass a medical examination.

Applications stating District applied for, age, experience, and present position, and giving full particulars of training and qualifications, together with the names of two referees, should reach the undersigned not later than Friday, June 15, 1956.

K. L. PEARCE,
Divisional General Manager.

East Midlands Gas Board,
Notts. & Derby Division,
P.O. Box No. 62,
Friar Gate,
Derby.

EAST MIDLANDS GAS BOARD

LEICESTER AND NORTHANTS DIVISION
SECTION LEADER DRAUGHTSMAN

APPLICATIONS are invited for the position of SECTION LEADER DRAUGHTSMAN in the Divisional Headquarters at Leicester. Salary within Grade A.P.T. 8 (£710-£790 per annum) commensurate with qualifications and experience.

The person appointed will be engaged on layout work involving gas boosters, governors, etc., and associated pipework, and will be required to supervise the work of junior draughtsmen employed on detail drawing work. Preference will be given to a man holding the H.N.C. in Mechanical Engineering or equivalent, and experience in the Gas Industry, or similar, would be an advantage.

The position is pensionable and the successful applicant will be required to pass a medical examination.

Applications stating age, and giving details of education, qualifications and experience, together with the names of two referees, should be addressed to reach the undersigned not later than June 9, 1956.

H. B. TAYLOR,
Divisional General Manager.

Gas Offices,
Millstone Lane,
Leicester.
May, 1956.

ROYAL TECHNICAL COLLEGE, SALFORD

ACTING PRINCIPAL J. F. YATES, B.Sc. (Lon.), M.Sc. (Belfast), M.I.E.E.

APPLICATIONS are invited for the post of SENIOR LECTURER IN GAS ENGINEERING from suitably qualified candidates who should be Corporate Members of the Institution of Gas Engineers and/or should possess a University Degree or other equivalent qualification. Teaching experience is desirable and industrial experience is essential.

Applicants should be capable of teaching Gas Engineering, Distribution and/or Utilization.

Salary in accordance with the Burnham Technical Report, 1954, namely, £1,065-£1,215.

For further particulars and forms of application please send a stamped addressed envelope to the Principal, Royal Technical College, Salford 5. Applications should be returned as soon as possible.

R. RIBBLESDALE THORNTON,
Clerk to the Governors.

SOUTH EASTERN GAS BOARD

CHEMICAL LABORATORIES, WADDON WORKS, CROYDON
EAST SURREY DIVISION

VACANCIES exist for chemical staff at the Waddon Works.

Applicants to fill these vacancies should have had a systematic training in chemistry and should have a thorough knowledge of all tests and methods necessary for the chemical control of gasworks processes and plant.

The initial salary will be within Grades 4-6 (Met. Area)—£475-£720 p.a. depending upon qualifications and experience.

Applications in writing, quoting reference V10/690 and giving full details should reach the undersigned within ten days.

R. J. MCCRAE,
Personnel Manager.

Katharine Street,
Croydon.

(*Classified advertisements continued on page 782*)

There are all sorts of photographs . . .

. . . ranging from furtive to fine art. Whatever sort you want, the answer is always in the negative, if you see what we mean. But if you want *positive* results in industrial photography you could not do better than contact **Walter King Photographs,** 11, Bolt Court, Fleet Street, E.C.4. (Tel. FLEet Street 2236)

WALTER KING PHOTOGRAPHS

The sign of BETTER Photograhpy

APPOINTMENTS VACANT (*ctd.*)

WEST MIDLANDS GAS BOARD

BIRMINGHAM & DISTRICT DIVISION
VACANCY FOR HOME SERVICE ADVISER, NORTHFIELD

THE person appointed must have had at least two years' training in Domestic Science and hold an appropriate diploma. She should be capable of conducting cookery and laundry demonstrations using gas appliances.

The salary for the post will be within Special Grade 5 (Female) of the National Salary Scales for Gas Staffs. The commencing salary for the post will be within the range £436-£525 per annum with an eventual maximum of £580.

The position is pensionable and the successful applicant will be required to pass a medical examination.

Applications stating age, education, qualifications and experience, together with the names of two referees, should be addressed to Mr. J. E. Wakeford, Divisional General Manager, West Midlands Gas Board, Birmingham and District Division, Gas Offices, Edmund Street, Birmingham 3, to reach him not later than June 11, 1956.

J. C. INGRAM,
Secretary to the Board.

May 25, 1956.

WEST MIDLANDS GAS BOARD

BIRMINGHAM AND DISTRICT DIVISION
SHIFT SUPERVISOR—SWAN VILLAGE WORKS

CANDIDATES must be fully qualified to take control of the whole of the Works during periods when day technical staff is absent. They should have had experience in the Retort House, possess a sound working knowledge of water gas manufacture, wet and dry purification, be conversant with the operation of boosters and exhausters and also understand the operation of gasholders. Experience in controlling labour is essential.

The possession of a technical qualification, such as a Certificate in the Technology of Gas Manufacture, or its equivalent, will be an advantage.

The salary will be within A.P.T. Grade 9 (£755 × £25—£855 p.a.) of the National Salary Scales for Gas Staffs.

The post is pensionable and the successful candidate may be required to pass a medical examination.

Applications stating age, personal details, particulars of training, experience and qualifications, together with the names of two referees, should be addressed to Mr. J. E. Wakeford, Divisional General Manager, West Midlands Gas Board, Gas Offices, Edmund Street, Birmingham 3, to reach him not later than Monday, June 18, 1956.

J. C. INGRAM,
Secretary to the Board.

EDUCATIONAL

THE UNIVERSITY OF LEEDS

GAS PLANT MANUFACTURERS' DEVELOPMENT COUNCIL SCHOLARSHIP

APPLICATIONS are invited for the above Scholarship of a value of up to £215 a year; in special circumstances a higher award of up to £280 a year may be made. The Scholarship is provided to enable promising students to follow an Honours course in either Gas Engineering or Chemical Engineering as preliminary training for entry into the Gas Plant Industry.

The Scholarship is open to applicants of British Nationality from school or from industry; among the latter preference will be given to candidates already engaged in the Gas Plant Industry.

Applications should reach the Registrar, The University, Leeds, 2, from whom further particulars and forms of application may be obtained, not later than June 30, 1956.

THE UNIVERSITY OF LEEDS

CHARLES BROTHERTON SCHOLARSHIPS IN CHEMICAL ENGINEERING OR GAS ENGINEERING

APPLICATIONS are invited for the above scholarships of the annual value of £125 a year, provided to enable promising students to follow an Honours course in chemical engineering or gas engineering in the Department of Coal Gas and Fuel Industries with Metallurgy. In cases where the candidates reach the required standard, the scholarships may be supplemented by a State Scholarship awarded by the Ministry of Education.

The scholarships are open to applicants of British Nationality from school or industry, who are qualified to enter upon a degree course.

Applications should reach the Registrar, from whom further particulars and forms of application may be obtained, not later than June 30, 1956.

PATENTS

KINGS PATENT AGENCY, LTD.
(Director, B. T. King, A.I.M.E., Patent Agent)
Advice, Handbook, and Consultations free. 146a, Queen Victoria Street, London, E.C.4. 'Phone: City 6161.

PUBLICATIONS

GAS ACCOUNT CALCULATOR

SUPPLIED either by Price per Therm or Thousand, for any specific Calorific Value, in book form, office charts, or pocket charts for Meter Inspectors, printed in clear type. Write for particulars to F. H. WAKELIN, LTD., Calculator Specialists, 35 WHEELER STREET, BIRMINGHAM.

'Phone: Northern 0989. 'Grams: Reckoner B'ham.

"KLEENOFF" *
THE COOKER CLEANER

"KLEENOFF"
FIBRE BRUSHES
RUBBER MOPS

"KAY-DEE" *
KETTLE DESCALER

for resale to the public and in bulk for works use.

BALE & CHURCH, LTD.
7, CROMPTON WAY, CRAWLEY, SUSSEX

DOMESTIC
UTILISATION OF GAS
SMITH & LE FEVRE
20/- *inc. postage*
WALTER KING, LTD.
11, Bolt Court, Fleet Street,
E.C.4.

STRINGER BROTHERS
ALBION WEST BROMWICH

S.B
IRON & STEEL
PLATES & SHEETS
BARS & SECTIONS
Telephone:
WEST BROMWICH 0436-7

FOR HIGH EFFICIENCY GAS CLEANING

Specify

HOLMES ELEX

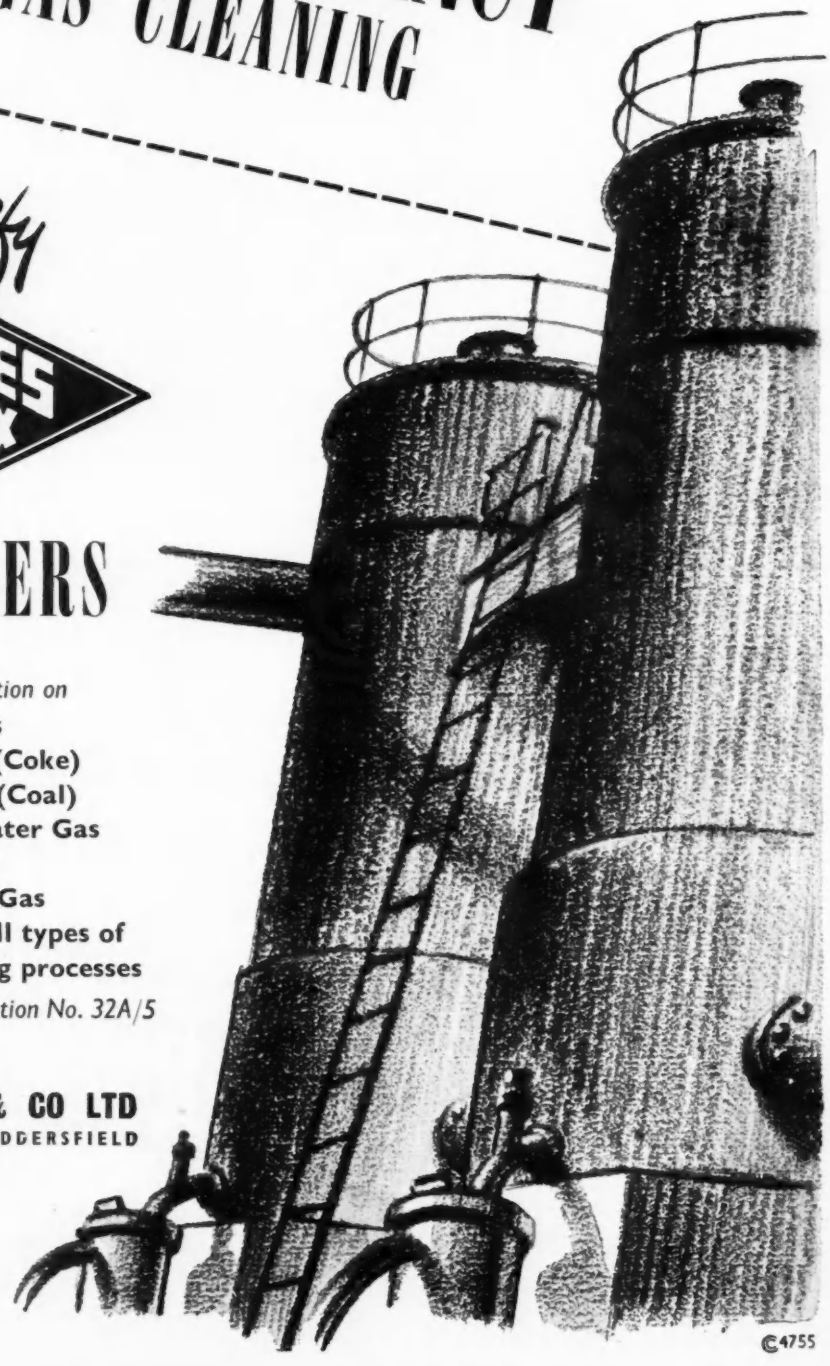
DETARRERS

Chosen for operation on

Coal Gas
Producer Gas (Coke)
Producer Gas (Coal)
Carburetted Water Gas
Oil Gas
Coke Oven Gas
and particularly all types of
Cyclic Gas producing processes

Please write for Publication No. 32A/5

W. C. HOLMES & CO LTD
TURNBRIDGE HUDDERSFIELD



C4755

TYPE 3 MIXTURE CONTROLLER

for accurate control of air blast systems

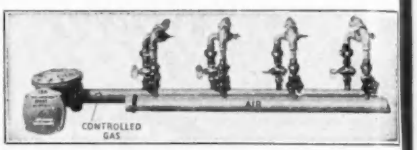
The Type 3 is the latest development in mixture controllers. Its function ensures exact proportioning of air and gas over a wide range of volumes despite the slightest variation of pressures.

Air pressures between ¼ lb. and 1 lb. are used normally but in special instances up to 2 lb. can be used.

Of robust unit construction, the assembly consists of a diaphragm valve, monitor governor and an injector which can be set in any one of four standard positions on site.

The Type 3 mixture controller is available in four sizes 1", 1¼", 1½" and 2". Write or 'phone now for particulars.

The Type 3 zero governor is a modification of the controller. Providing individual control of burners, it gives greater effective control of heat distribution, facilitates burner ignition and has greater sensitivity and range than previous types.



INDUSTRIAL GAS EQUIPMENT

Keith Blackman Ltd
MILL MEAD ROAD, LONDON, N.17
TEL: TOTTENHAM 4522 (12 LINES)

If air blast arrangements are not already installed a K.B. High Pressure fun will provide, as a rule, greater efficiency and economy than a positive blower or compressor of equal capacity. These fans may be supplied with or without K.B. made motors as required.

601

UNDERPRESSURE ENGINEERING CO., LTD.

UNDERPRESSURE CONNECTIONS
SPLIT COLLARS
SOCKET CLIPS

UNION FOUNDRY, MANSFIELD, NOTTS.
ALL TYPES OF DISTRIBUTION MATERIAL IN STOCK
Service Enquiries :
STAFFORD HOUSE, NORFOLK STREET, STRAND, W.C.2.
'Phone: MANSFIELD 1256. *'Grams:* CASTINGS, MANSFIELD.
'Phone: TEMPLE BAR 9910. *'Grams:* WASHER, ESTRAND, LONDON

CENTRAL ACTION DRILL STANDS
SERVICE CLEANSERS
TOOLS, ETC.

COAL AND COKE SCREENING & SIZING PLANTS.

RETORT SETTINGS PRODUCERS, FURNACES REPAIRS.

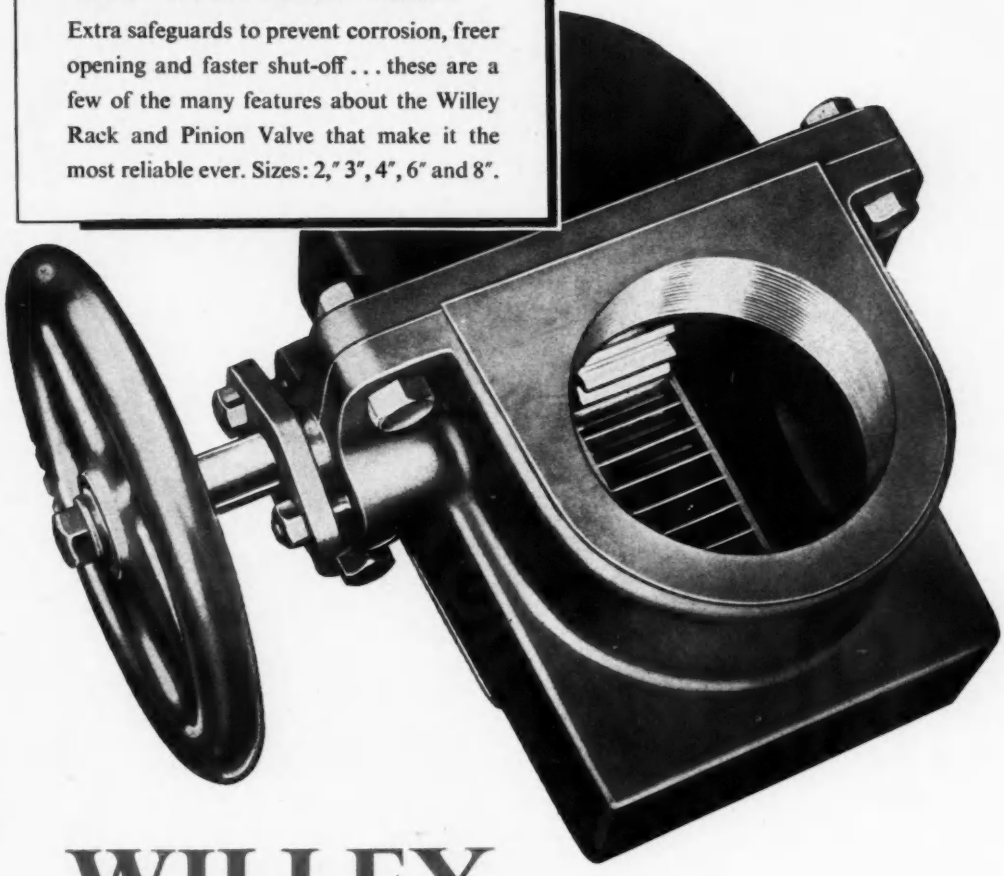
GOODALL, CLAYTON & Co. LTD. — LEEDS.

CONVEYORS, ELEVATORS, BUNKERS, ROOFS, HOISTS, etc.

Registered as a Newspaper. Printed by STRAKER BROTHERS LTD., E.C.2 for WALTER KING LIMITED, 11, BOLT COURT, FLEET ST., LONDON, E.C.4.. Wednesday, June 6, 1956

RACK AND PINION VALVE

Extra safeguards to prevent corrosion, freer opening and faster shut-off . . . these are a few of the many features about the Willey Rack and Pinion Valve that make it the most reliable ever. Sizes: 2," 3", 4", 6" and 8".



WILLEY
PRECISION VALVES

The Rack and Pinion Valve is a typical example of Willey precision castings. Pinion and buffers are made from a specially selected grade of corrosion-resisting bronze. The body seating is kept free from deposit by means of a coil spring action. Possibility of jamming has been virtually eliminated by precision machining of the pinion teeth. An extra-secure packing gland is incorporated, while precision-machined tapers ensure free opening and fast shut-off at all times. The 2", 3", 4" and 6" sizes are available with screwed or flanged ends.

OTHER FAMOUS WILLEY VALVES

Cast Iron control valves

Gate valves

Gunmetal steam wheel valves

Gunmetal handy valves

Three-way valves

U·G·I GROUP

GAS ENGINEERS

WILLEY & CO. LTD · EXETER · LONDON · MANCHESTER · LEICESTER · DARLINGTON

ASSOCIATED COMPANY OF UNITED GAS INDUSTRIES LIMITED

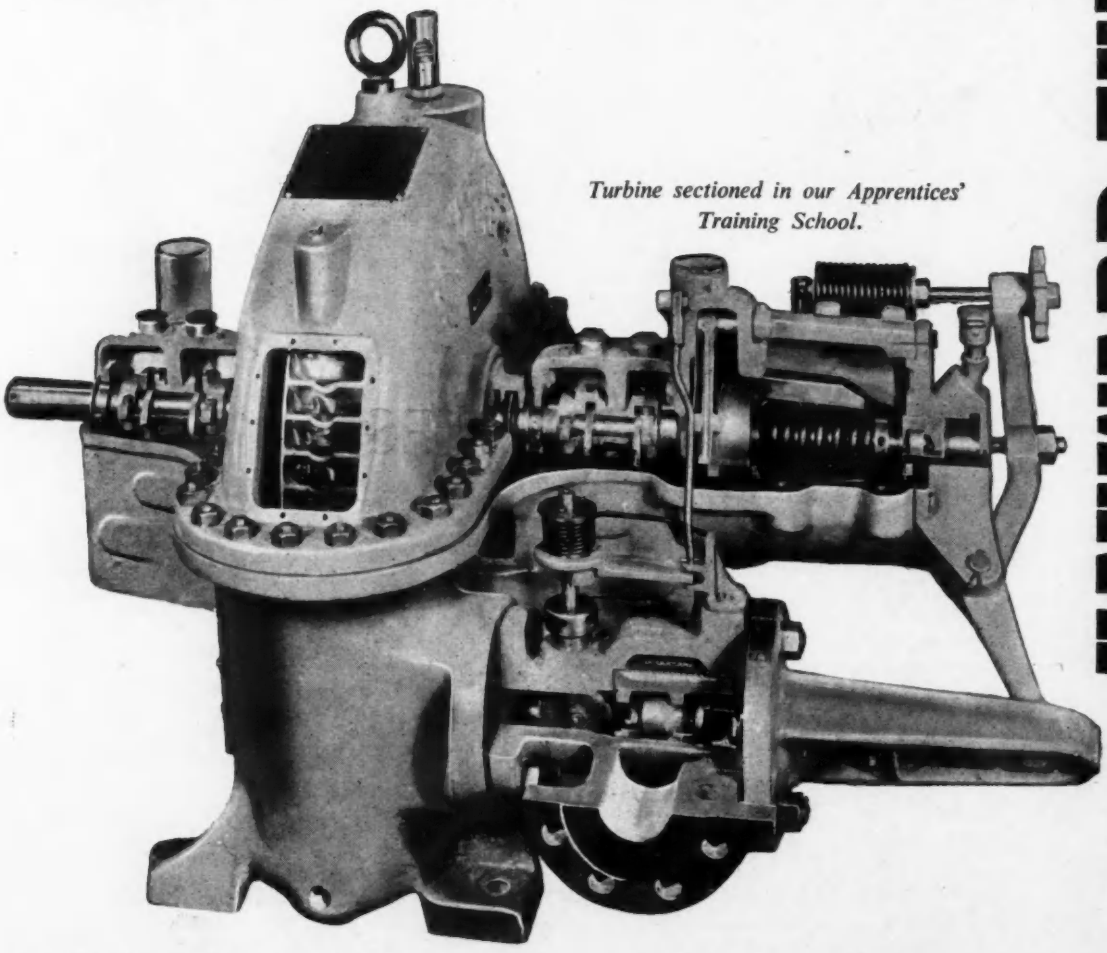
750°F

Improvement in the design of the Hayward Tyler-Terry steam turbine now makes it suitable for steam temperatures up to 750°F without the necessity for force feed lubrication.

This further widens the field of application for these simple and robust prime movers, already used in large numbers for driving Fans, Blowers, Compressors, Pumps, Alternator Sets and Asynchronous Generators.

Type Z	5 to 150 H. P.
Type ZS	5 to 200 H. P.
Type G	75 to 575 H. P.

Other Hayward Tyler products: Process Pumps, Chemical Pumps, Oil Cargo Pumps, Submersible Borehole Pumps.



Turbine sectioned in our Apprentices' Training School.

HAYWARD TYLER

HAYWARD TYLER & COMPANY LIMITED LUTON & EAST KILBRIDE LUTON 68
LONDON OFFICE: SALISBURY HOUSE FINSBURY CIRCUS E. C. 2 NATional 93